THE IMPACT OF MAN ON THE VEGETATION AND SOIL OF THE UPPER VALLEY ALLOTMENT GARFIELD COUNTY, UTAH

By

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A thesis submitted to the faculty of the University of Utah in partial fulfillment of the degree of Master of Science.

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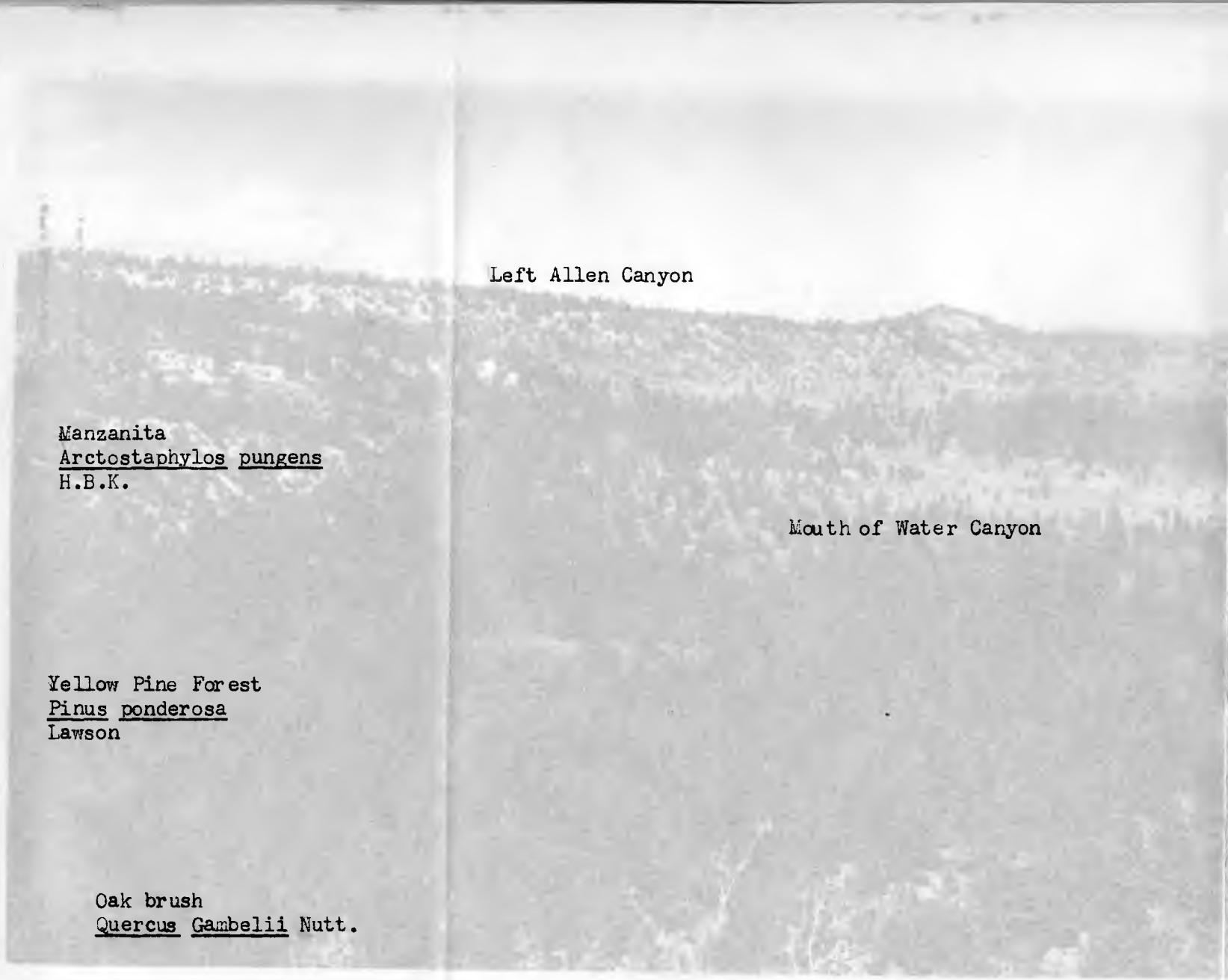
1954


Left Allen Canyon
Manzanita
Arctostaphylos pungens
H.B.K.
Mouth of Water Canyon
Yellow Pine Forest
Pinus ponderosa
Lawson
Oak brush
Quercus Gambelii Nutt.

Henry Mountains

Pigmy Forest

Upper Valley

Upper Valley Ranger Station

Yellow Pine Forest
Pinus ponderosa Lawson

Oak brush
Quercus Gambelii Nutt.

Western Extensions of
Kaiparowits Plateau

Canaan Mountain

Pigmy Forest

South Hollow

Meadow of Upper Valley

Pole Springs

Yellow Pine Forest
Pinus ponderosa Lawson

Frontispiece: A Panoramic View of the Upper Valley Allotment, Garfield County, Utah
August 1952

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INTRODUCTION

The writer began this study with three purposes in mind: (1) to better understand what impact man with his many cattle and sheep has had upon the open range of the Escalante area in southern Utah; (2) to determine what effect accelerated erosion and reduced forage of the open range has had upon the economy of the locality; and (3) to provide, if possible, some information which might be considered pertinent to the rehabilitation of this area, so scarred and ravaged from man's misuse of the land.

The Upper Valley Allotment was chosen as the site where one could conduct such a study because plant succession there seemed current and many physical changes had occurred. Many data were available in relation to this area. Forest Rangers of the U. S. Forest Service have long been aware of the overstocking of sheep and cattle within the area. The carrying capacity (as computed by the Forest Rangers) is still below the present number of stock grazing this range.

The area of Potato Valley, now known as Escalante Valley, has for many years been of keen interest to the geologist and the biologist. Its diversity in climate, physiography and natural habitat provides an unusual number of ecological niches in which both animal and plant forms have extended their range and evolved into new units or sub-species.

To the ecologist and conservationist the area provides a challenge. To reconstruct in one's mind what must have been observed by such men as John Heaps, Rufus Liston, Tom Alvey, Joe Spencer, Filo Allen and other

early cattle and sheep men as they made their way into this mountain meadow and benchland is rather difficult. But it is not difficult for the ecologist to visualize the devastating impact that man, with his uncontrolled numbers of sheep and cattle, has had upon the open range. Nowhere in the State has the abuse of the open range affected the people so critically as it has these people in the Escalante Valley; nowhere have the results of this abuse of the open range been so devastating to the cattle and sheep men as they have been in the community of Escalante, Utah.

ACKNOWLEDGMENT

I acknowledge my indebtedness to Dr. Walter P. Cottam, chairman of my committee, for patience demonstrated throughout my work and for his many suggestions which clarified the meaning of material written in this thesis. I wish to extend my thanks to him for the time spent in the field with me collecting pertinent data which are included in this thesis.

I want to extend my sincere appreciation to Dr. Stephen D. Durrant, Department of Zoology, for the time spent with me in the field, and for invaluable assistance and information relating to the mammals of the area of which a checklist of the species is included.

I wish to thank Dr. I. B. McNulty for suggesting the problem to me and for the time he gave me in the field and the suggestions he gave for the writing of this thesis.

I want to extend my thanks to Dr. Vasyl Gvosdetsky, Department of Geography, for spending two days in the field with me pointing out specific features of the soil profile, its development, its use, and its abuse.

To Mr. Reed Thompson, U. S. Forest Ranger of the area, I am deeply indebted. His time spent with me in the field pointing out specific data which are included in this thesis proved most useful. I also thank him for extending permission to use the historical records and range notes he has in his files.

I appreciate the money given to me by the University of Utah Research Fund. The rental of saddle horses for which this money was used made it

possible for me to explore the entire Allotment.

I am not unmindful of the many hours spent by my wife, Shirley, in typing and retyping the many pages of this thesis before it was approved, and for the continuous support she gave to me throughout the entire study.

DESCRIPTION OF THE UPPER VALLEY ALLOTMENT

The Table Cliff Plateau, Barney Top, Upper Valley, and Canaan Mountain together compose the 67 square miles of the Upper Valley Allotment of the Dixie National Forest Preserve.

The Table Cliff Plateau and the Barney Top are located on the west side of the valley, forming the southern-most extensions of the Aquarius Plateau. The Aquarius Plateau being L-shaped runs from Scout Lake at the east to Table Cliff Plateau 65 miles southwest. Here the Table Cliff Plateau has been elevated over 2,000 feet above the once continuous topography of the Paunsaugant Plateau. This elevation, 10,577 feet, is a result of the Paunsaugant Fault, which runs from Tropic, Utah, along the west side of the Table Cliff Plateau toward Widtsoe, Utah.

The summit of the Table Cliff Plateau is capped with lava and, as its name suggests, is flat in outline. Its face consists of a succession of inaccessible precipices of limestone outcroppings with steep, broken, tree-clad talus slopes (Fig. 8). At the base of these talus slopes, long ridges run out to the edge of the valley. These ridges are separated by deep canyons and gullies on either side.

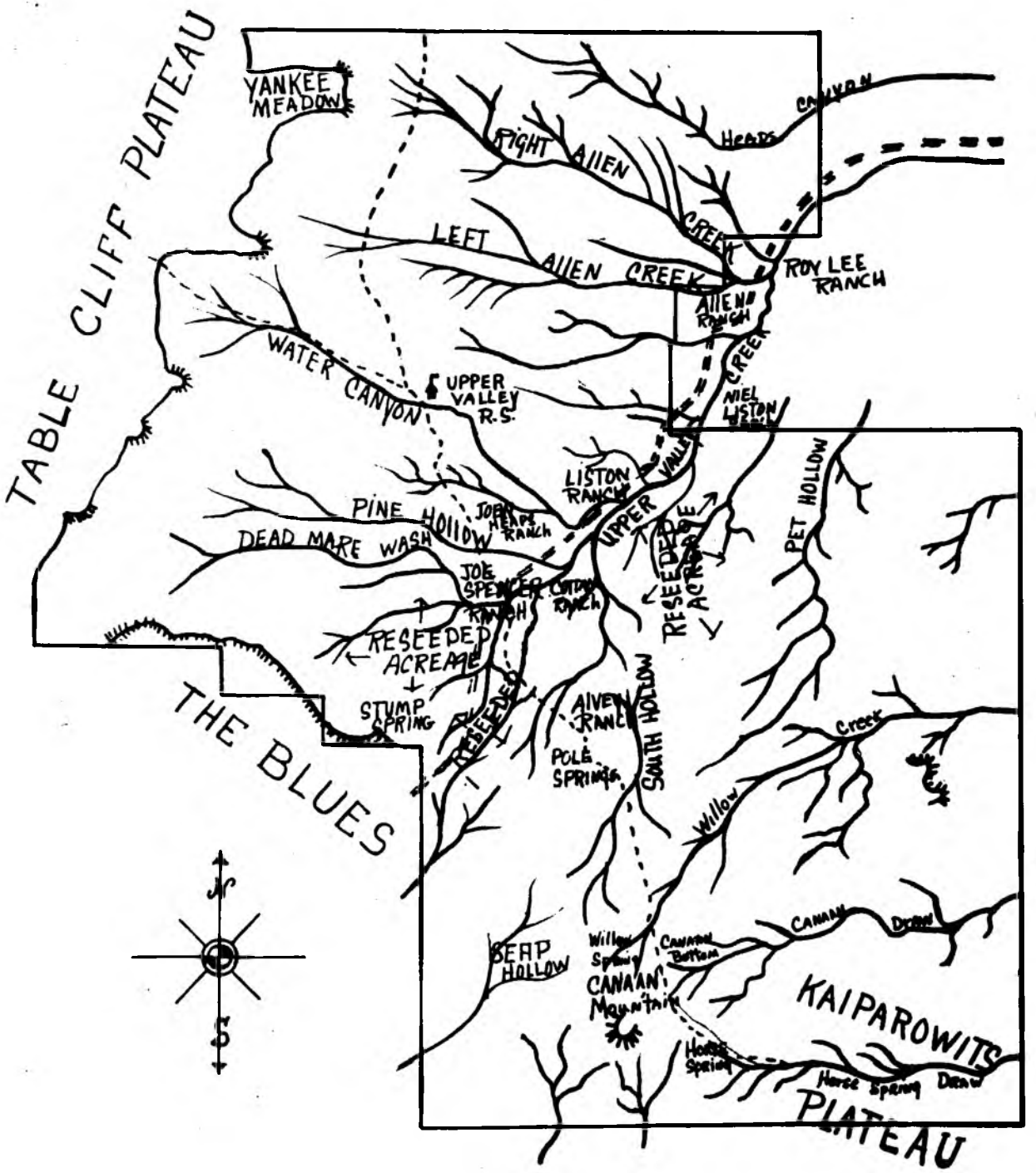
The ridges running out from Table Cliff Plateau to the valley are covered at their upper elevation with Pinus ponderosa, and at lower elevations they support a pinyon-juniper association.

The Upper Valley itself heads at the brink of the Blues, an eroded clay formation, remnant of the old Cretaceous Sea, running east at the southern-most end of the Table Cliff Plateau which drains into the Paria River. The valley which begins at the Blues is 8 miles long and from 1/2 to 2 1/2 miles wide. Fingering out from the main valley are many

small valleys which drain into the Upper Valley arroyo. The bottom land is privately owned, fenced, and utilized for summer pasture. There are 1,200 acres of reseeded land in the valley controlled and regulated by the U. S. Forest Service.

A large gully system has developed throughout the entire valley. The main arroyo courses along the east side of the valley. At the head of the valley the arroyo is 5 feet deep and 10 feet wide. At the mouth of the valley, some 8 miles northeast, the channel is 206 feet wide and 84 feet deep. The average depth is 30 feet, and the average width is 69 feet in the main wash. Some notion of the average depth and width of the wash may be gained from Figure 14.

The Canaan Mountain, forming the southeast boundary of Upper Valley, is the westerly and most northerly extension of the Kaiparowits Plateau. It reaches a maximum elevation of 9,196 feet, and rises abruptly above the adjoining plateau country. The drainage from Canaan Mountain, because of its conical shape, is in all directions, the north slopes draining into the Upper Valley. The extensive benchlands of the Canaan Mountain is covered with scrub oak, mountain mahogany, and ponderosa pine at the upper elevations and with the pinyon-juniper association at the lower elevations. To the southeast these benchlands terminate in a network of sharp ridges several hundred feet high, which ramify through the Kaiparowits Plateau. This area, like that of the Upper Valley itself, is channeled with many deep gullies.



UPPER VALLEY ALLOTMENT

HISTORY OF THE AREA

The story of the settlement of the Upper Valley and Escalante is well known. The first white men to visit the area were a group of Mormon cavalry, under the leadership of Captain James Andrews, in pursuit of Indians during the Black Hawk War of 1866. Escalante was not settled, however, until 1875. In the autumn of that year a group of men from Beaver, Utah, investigated Potato Valley, as it was known at that time, with a view of establishing a settlement. They laid out the most available farm land near the creek in plots of 22 1/2 acres each. They were not interested in individual acquirements of large holdings, but in securing small farms for themselves and in having land available for other prospective settlers.

This co-operative planning was evident in all of the economic affairs of these early settlers. They established a co-operative store, a co-operative irrigation company, and in light of the subsequent happenings it is a pity that these early settlers, in staking out the arable land and water, did not likewise organize control of their most valuable natural resource--the summer and winter open range.

A rather rapid development of the area came after knowledge of the rich expanses of summer and winter range land had reached the outside localities. Many herds were brought to graze this open range. Hyrum Fowler brought the first herd of cattle into the area in 1877. Joseph Lay followed soon with another large herd. The Liston brothers, Martin, Rufus, and Joseph, brought small herds from the Pine Valley region. These herds grew with great rapidity because of the unrestricted summer and winter range where occurred an abundance of good forage.

In 1889, Napoleon Roundy and his brother Wallace brought from the northern part of the State some 2,000 ewes and lambs. These were the first sheep to enter the valley. Soon after this, other herds of sheep were brought into the area to graze the winter range. Joseph Barney married a widow from upstate and brought her large herd of sheep, some 5,000 ewes, to winter on the Escalante Desert. (This desert of the same name should not be mistaken for the Escalante Desert in Iron County.) That same year Charles Griffin and his sons Joseph and Ernest came from Orderville with a large herd of sheep. All of these stockmen mentioned came as settlers to the community. They bought or built homes, acquired small farms, and established themselves as integral parts of the community. Unfortunately they were followed by others who had little or no intention of making permanent residence in the town or in helping to build the community, their sole interest being in the free and well-conditioned range. Unfortunately, both transient and permanent residents held to a short-sighted policy of seizing the profits of this natural resource without thought of the future. These were called the "good old days," when a man could turn his cattle on the open range and scarcely go back to look at them until time for the round-up and sale.

Mr. Ernest Griffin states (Standing, 1935):

"I brought about 1,500 head of sheep with me. About this time this country was getting a wonderful reputation for its range land. About 1885 there were some 15,000 head of sheep in this vicinity. The first settlers brought a lot of cattle with them, but by 1885 and 1890 many cattle were being brought into the country to winter. There were perhaps 15,000 head of cattle owned by people here besides a couple of thousand head of wild

Escalante Mountain

Pigmy Forest
Foothills

Pigmy Forest
Foothills

Fremont Poplars
Populus Fremontii Wats.

Alfalfa Field

Sand Bar Willow
Salix exigua Nutt.

Road through Main Arroyo

Utah Juniper
Juniperus osteosperma (Torr)

Rabbit-brush
Chrysothamnus nauseosus (Pall.) Britton

Fig. 2. The Escalante Creek. This shows the north lane leading to the fields. In 1880 this creek was only 12 feet wide and less than 2 feet deep, whereas today it is over 130 yards wide and 20 feet deep.

horses. They were all over the desert.

"The desert used to have a lot of white greasewood on it, (Atriplex canescens (Pursh) Nutt.) but all this has been killed out before now. There were also lots of sand grass and other grass that looked like wheat grass but is fuzzy on top (Hilaria Jamesii (Torr.) Benth). Then, too, there was a lot of buffalo grass like that there now (Bouteloua gracilis H.B.K.). All of the other grasses have been killed out except the buffalo grass.

"My father and I were the first men to take sheep onto the mountain (now forest reserve). We used to run our sheep up North Creek and a few years later we moved them out onto the Griffin Top. We built cabins and stayed in them and, as was the practice at that time, we bedded our sheep near them each night. At that time the feed was good and I believe that the grasses growing there at that time are the same as growing there now except there used to be a lot of bunch grass (Agropyron trachycaulum (Link) Malte) growing around the timber in the edge of the open flats."

Mr. Joseph J. Porter states (Standing, 1935):

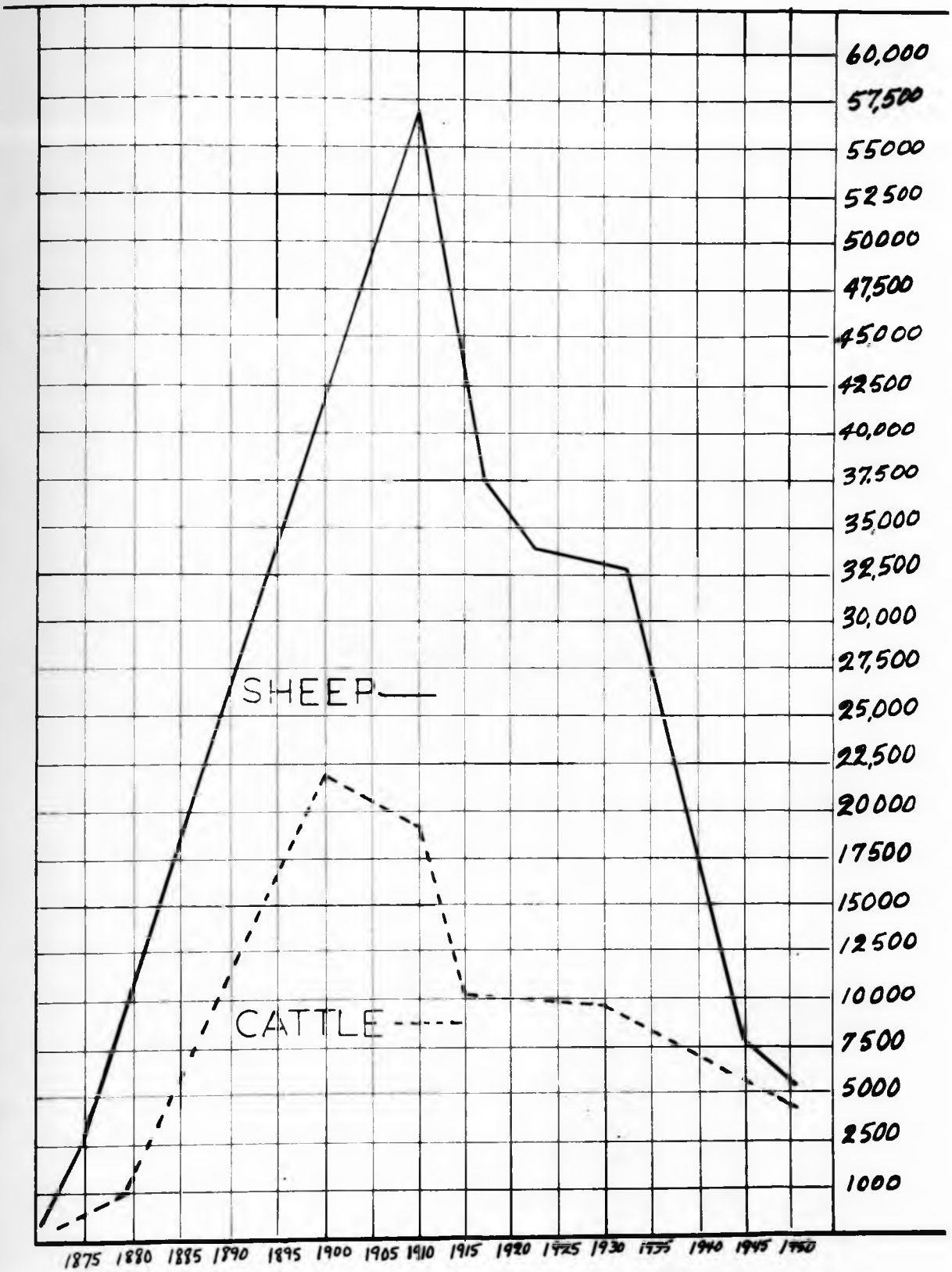
"I helped the Griffins take their sheep out on the Griffin Top about the first time sheep were ever taken out there. That was about 1890. I remember the grasses were so high that we could hardly see the sheep for it. Griffin Spring Draw was just a large willow patch from one end of it to another. While we were herding the sheep in that country we never did turn our horses loose, we just tied them with a long rope and they would get all they wanted to eat throughout the night. We also brought our sheep back to the same bed ground each night and they never had to go very far

during the day to get all they wanted to eat. We did the same down in the desert during the winter. They bedded their sheep on the same bed grounds for three or four months at a time. Griffins built some small cabins and camped in them all winter. Everyone handled their stock the same way until feed started to get scarce, then they had to move around for good food, but they never had to take them off the desert.

"Even at the time the Forest was created the mountain was badly depleted and the floods in the streams were very common. At that time about 150,000 head of transient sheep were forced out of the country because the government would not issue permits to them. Since that time the mountain or forest range has come back considerable, but I don't believe it is over 50% as good as it used to be. The desert range has continued to go down until it will care for less than 10% of what it would formerly."

At one time, we are told by such people as Jasper Osborn, Ernest Griffin, Joseph Porter, Rufus Liston, the people of Escalante owned 20,000 head of cattle, 45,000 head of sheep, and 2,000 head of wild horses (Fig. 3). Hyrum Gates said that in 1903 he "docked 45,000 lambs at the old shearing corral on the desert" (Personal communication). As late as 1920-23 Horace R. Hall said "they had a twenty-man shearing plant on the desert in the spring and it required 30 to 35 days to complete the shearing" (Personal communication). In 1925 there were 10,000 head of cattle, 33,000 head of sheep, nearly 1,000 head of horses, and 640 dairy cows (Nelson, 1950).

Fig. 3. Number of Sheep and Cattle in Escalante, Utah from 1875 to 1950.



NUMBER OF SHEEP AND CATTLE IN ESCALANTE UTAH FROM 1875 TO 1950

HISTORY OF THE UPPER VALLEY ALLOTMENT

It was in 1872 that Major J. W. Powell with a survey party traversed the Upper Potato Valley and the area where the present community of Escalante is now located. Stephen Vandiver Jones, who was a member of the group, wrote in his Journal:

Sunday, June 2nd.

"Started up a narrow ridge of clay shale just as the rain began to fall in earnest. Spent an hour in going up about a thousand feet, packing several animals on the narrow ledges. At the summit found plenty of cedars and the head of a grass covered valley, down which we went about two miles and made camp on the small ridge running down from the Table Mountains, near a cold, clear spring. Plenty of large pine trees." (Pinus ponderosa Lawson).

Monday, June 3rd.

"Broke camp at 10 a.m. and traveled down a valley from 3/4 of a mile to 1 1/2 miles wide, rising to mountains, on either side covered with pine timber (Upper Potato Valley). Numerous springs on each side of the valley, grass splendid, soil good, mud deep. Six miles from camp the valley canons. Passed two creeks running in from the left, both very muddy (Right Allen Creek and Left Allen Creek).

Wednesday, June 5th.

"Spent nearly an hour in crossing the creek above the junction (of Birch and Upper Potato Valley creeks) and getting around a point of rocks. Then went down the valley on the right banks, across deep gulches " (Jones, 1871-72).

J. W. Powell, leader of the party, reports his impressions of the large area thus:

"From camp No. 5 we followed up the Paria River to its junction with the Table Cliff Creek; then up the latter to its source. Here we climbed a thousand feet up a steep, clay ridge, having an average slope of 20°, and often nor more than five feet in thickness at the top, to the head of a narrow valley called Potato Valley. Down this we traveled three miles, and made camp No. 6 at a cool spring, in the middle of a beautiful meadow, 1,500 feet above our camp on the Paria River, and about 7,200 feet above the sea.

"So far as I have been able to ascertain, we were the first white men to visit the plateau. The Indian name for a small elevation near the north end is Kai-Par-o-wits, so we called the whole plateau by that name" (Powell, 1871-72).

These are the first reports of the Upper Potato Valley. Limited as these reports might be, they are extremely significant as historical data of this area. There are three outstanding features mentioned that would astonish the visitor there today. (1) They entered "a grass covered valley." (2) There were "numerous springs on each side of the valley." (3) In the valley they camped by a "beautiful meadow" and saw "grass splendid, soil good, and mud deep."

Only seven years after Powell and Jones made these observations, men began to homestead the valley and divert the streams and spring waters onto land for irrigation purposes.

Filo Allen homesteaded at the mouth of the Upper Valley canyon in 1879.

His ranch produced grass hay which he cut from the meadow. At the turn of the century, Henry Heaps homesteaded 160 acres of land at the mouth of Water Canyon. Seventy acres of this were arable land. The creek provided him one second foot of water for irrigation purposes. Mr. Heaps relates that in the early 1900's his farm produced 40 tons of alfalfa hay to the cutting and 600 bushels of grain on 22 acres or 28 bushels per acre. At that time other ranches in the valley were producing similar quantities of grain and alfalfa hay. The Liston Ranch just down the canyon was producing 90 tons of grass hay annually on 45 acres of meadow. The Joe Spencer Ranch just west of the Liston Ranch was cultivated and produced both grain and alfalfa hay. Mr. Joseph Porter said his "father operated a threshing machine in the Upper Valley in the early 1900's and that he threshed at the Larce Cottam and William Alvey ranches over 4,000 bushels of grain." The Cottam Ranch had about 75 acres of cultivated ground and the Alvey Ranch had only 35 acres under cultivation. This amounts to 36.4 bushels of grain per acre--a high yield! The Wright Ranch in the mouth of the canyon also produced both grain and alfalfa hay. It produced 35 bushels of wheat per acre.

The open range of Upper Valley, like other parts of Southern Utah in the 1880's was utilized by optimistic herders who could see no end to the lush grass and browse forage.

Cattle and sheep were brought to graze the Upper Valley from Henrieville, Cannonville, Tropic and Escalante. The number of these early herds is not well known. Mr. George Ormond of Boulder, Utah, reports that in the 1880's there were over 10,000 head of transient sheep grazing the

vicinity about the Canaan Mountain " (Personal communication). Obviously the herders tending these sheep did not restrict them from grazing the Upper Valley itself and the adjoining ridges of the Table Cliff Plateau, so rich in forage at that time.

The vegetation of these valley floors was dominated by grasses. Mr. Joseph Porter reports that in the early days, when white men first began to utilize the Upper Valley for grazing, grasses reached the stirrups of the saddles when riding through them. Mr. Robert Hall reports that in the valleys adjoining the Upper Valley one could not see his sheep because the grasses were so tall (Personal communication).

The Liston Brothers grazed some 4,000 cattle on the Kaiparowits Plateau and the Canaan Mountain.

Mr. Andrew Spencer reports that in 1906, before the U. S. Forest Service was established, he, his brother and his father owned over 4,200 head of cattle which grazed the west side of the valley and mountain, in addition to all the cattle and sheep that other ranchers allowed to graze that area. He also states that their method of over-utilization of the land has brought about the present depleted range condition of the Upper Valley (Personal communication).

Mr. Ray Shirts and sons utilized the area about the Canaan Mountain and also the Upper Kaiparowits Plateau. On these areas they grazed approximately 4,000 head of ewes and lambs each summer. I rode recently over the range with him and his son. They spoke repeatedly of the time when one could not ride a horse on the north-facing slopes because of the dense cover. They also spoke of the many grasses and browse plants that once covered the area about the Canaan bottoms and Squealer.

Mr. Heaps recounts the time when the cattle buyers from Sevier County came to buy cattle in the area. They always paid more for the cattle in the Upper Valley than those in other parts of the area because of their fatter condition (Personal communication).

The number of stock grazed in the early history of the allotment comes only from the memory of these old-timers. However, in 1910 there were Forest Service permit rights for 4,689 cattle and no restriction on the number of horses which might graze the range. Also permitted were 2,300 head of ewes and lambs. Figure 3 shows a progressive decline in the number of cattle and sheep grazing the allotment after 1910, and by 1951 the U. S. Forest Service determined the carrying capacity to be no greater than 900 head of cattle, and all the sheep had been removed from the area about the Canaan Mountain until a carrying capacity could be determined (Fig. 22).

The ranches all have been abandoned, with no permanent residents inhabiting them today. The cultivated fields have grown into a succession of weeds and herbaceous plants. The irrigation ditches have filled with soil and the houses and adjoining buildings rapidly deteriorated from neglect. Agriculturally speaking, there is no harvest in the Upper Valley today except for a small irrigated field of alfalfa on the Filo Allen Ranch. The Liston, Spencer, and Heaps Ranches all have been fenced and utilized as summer pasture, supporting only 20 to 25 calves throughout the summer months.

Pigmy Forest

Chenopod Association
Sarcobatus & Atriplex

Upper Valley Arroyo

Sand Bar Willow
Salix exigua Nutt

Wet Meadow

Bullberry Brush
Shepherdia argentia
Pursh

Pinyon Pine Tree
Pinus edulis Engelm.

Fremont Barberry
Berberis Fremontii Torr.

Fig. 4. The Remaining Wet Meadow. The once extensive wet meadow that blanketed the entire Upper Valley floor from the Liston Ranch to the Allen Ranch is now restricted to approximately 20 acres on the Liston Ranch.

GRAZING PRACTICES, RESOURCES, AND ABUSES OF THE UPPER VALLEY ALLOTMENT

The method used by early herders in bedding down their sheep soon made corrals of the bedding areas. Even though these corrals were only used for short periods of time in some places, they were often the cause initiating erosion.

These bedding corrals, two to three acres in size, were usually established near a spring or stream bottom, a suitable place for the herders to set up their camp, where water for the herd and for themselves could be obtained. The bedding corrals were used for several weeks at a time. The practice of confining the herd to these corrals soon destroyed the entire vegetal cover in the immediate area. The trailing of the sheep to and from the bedding grounds made powder of the soil, and deep trenches soon led out from them. Such a complete disturbance of the soil surface and plant cover occurred in these areas that even moderate rains initiated an erosion cycle.

The roads, then as now, were coursed along the path of least resistance. Trails often followed paths charted by wild game, but other times they followed the canyon bottoms and down the faces of steep slopes. These trails often resulted in deep trenches. Some of these trenches established in the old trails have been measured to a depth of 8 to 10 feet. One of particular note is found in the Canaan bottoms. Another is located just west of the Ranger Station in the mouth of Water Canyon. These trails still show active erosion in time of rain.

The first herders naturally utilized the areas about the vicinity of

the ranches. The close proximity of the foothills to the adjoining ranches made this area attractive for large herds. The vegetation was reduced (according to Davis' findings in 1943) to a density of 18 per cent cover on these foothills where a meadow had previously existed.

Today a condition exists in this area which has no feasible remedy. The cost of constructing watering holes would be enormous. The area about the Canaan Mountain and the Table Cliff Plateau has limited watering holes for livestock. The stock grazing the area must travel several miles each day to get water. In the vicinity of the Canaan Bottoms and the Squealer, the stock are forced to travel 5 to 6 miles to water. This continued trampling and nibbling of the vegetation about the watering holes and along the trails leading to them has had a drastic effect upon the vigor and stability of forage plants. There is no immediate solution to this problem except to pipe water through the area, making more watering places available to the stock on areas of relatively more abundant forage. Immediate consideration of this present condition is needed if the unnecessary trampling of the vegetation and the soil surface spading by the herds of livestock are to be arrested (Fig. 5).

Saw mills were built soon after the first settlers reached the Escalante area. The first one was built in North Creek in 1880 by Henry White. The areas about these old saw mills are characterized by man's wastefulness and misuse of his resources. All the ponderosa pine were cut within a radius of two miles regardless of their state of maturity. All seed trees were removed. The cut-over stumps range in size from 6 to 30 inches in diameter. The small trees were used for building corrals,

Ponderosa Pine
Pinus ponderosa Lawson

Cliff Rose
Cowania mexicana D. Don.

Scrub Oak Brush
Quercus Gambelii Nutt.

Match Stick
Gutierrezia Sarothrae (Pursh)

Snowberry
Symphoricarpos oreophilus Gray

Fig. 5. The Mid-Montane Brush. The oak, cliff rose, and mountain mahogany are shown hedged back to diameters of 1/2 inch.

stables and barns, and the larger ones were sawed into lumber. This complete denudation of forest trees in the vicinity of the saw mills was significant in contributing to the beginning of the cycle of erosion which started in the 1890's.

The soils in the valley, cultivated to produce farm products necessary to sustain the ranchers, were rendered useless in the early 1900's when floods descended on them from the ravaged ranges of adjacent high elevations. The abandonment of these ranches left a bare earth which to the present time continues to be wasted away by accelerated erosion.

PHYSICAL FACTORS OF THE ALLOTMENT

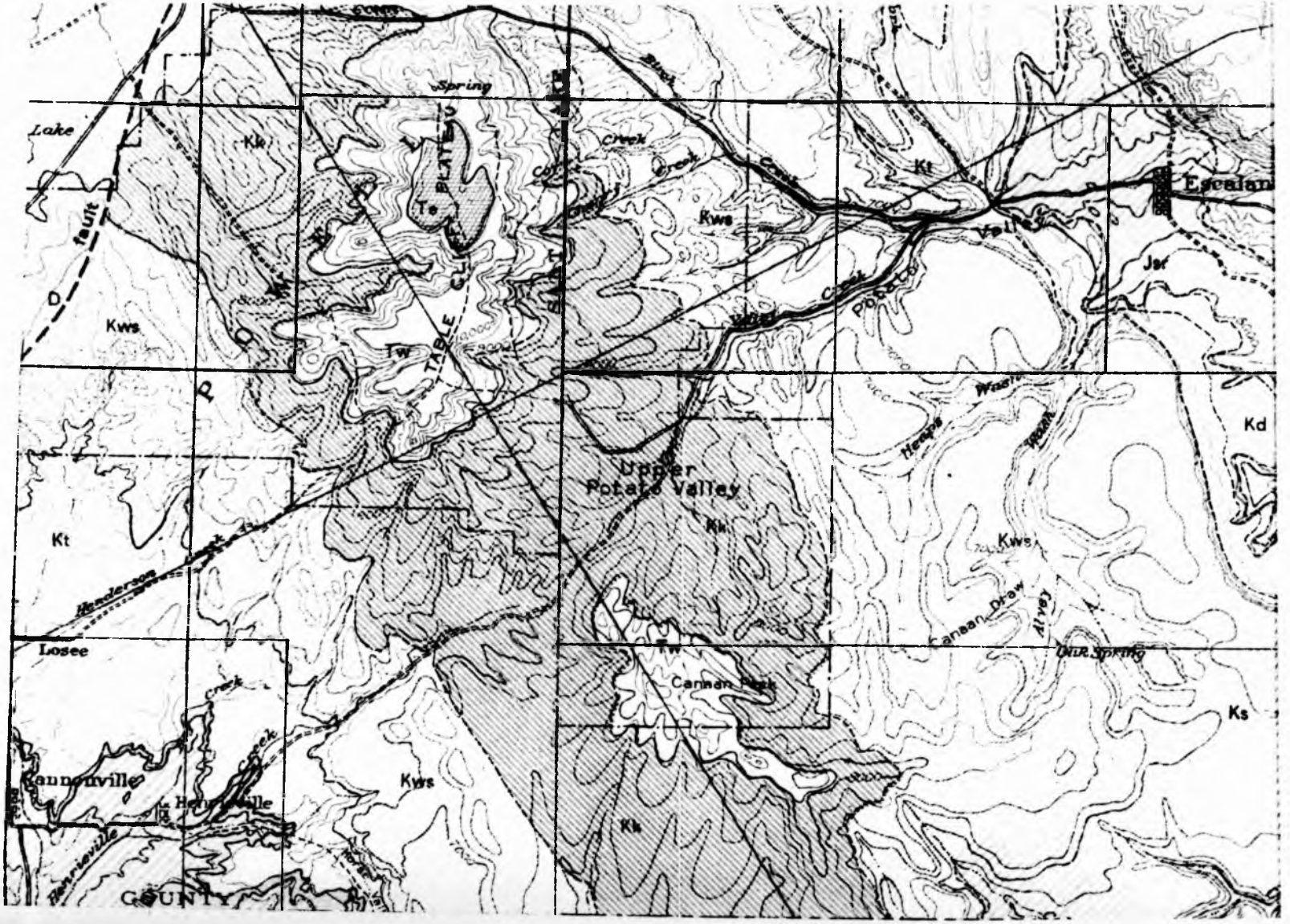
Topography

Dutton, in his paper "High Plateaus of Utah" (1880) in discussing this section of the high plateaus of the Colorado River drainage, describes the area about the Canaan Mountain and the Table Cliff Plateau as a rough, broken drainage emptying into the Paria and Escalante Rivers. "The Kaiparowits Plateau presents an excellent example. Its surface is in many places rendered utterly impassable by a plexus of sharp narrow canons, of which the heads have been cut off by the recessions of the gigantic cliff which forms the eastern wall of the plateau. They have long been dug, and have remained with but little change for an immense period of time" (Dutton, 1880).

The main drainage of the allotment flows northeast through the valley floor. Its tributaries from the Canaan Mountain are South Hollow and Dry Wash, which drain north into the Upper Valley Wash. The eastern side of Canaan Mountain is drained by Willow Creek, Canaan Creek, Horse Creek, Henrieville Creek and Dry Creek. All of these drainages show an abrupt descent into the contiguous topography about the Canaan Mountain. These drainages have in many areas cut deep channels as their streams have flowed downward in all directions from the conical peaks of the Canaan Mountain (Frontispiece).

The Table Cliff Plateau reaching some 2,000 feet about the valley rises in almost vertical ascent in many areas (Fig. 8). The main drainage from this plateau is Water Canyon. This canyon is a permanent source of water. The canyon's mouth shows scars of past and current erosion. The head of the canyon is a large cirque, heavily forested with aspen-fir

Fig. 6. Contour Map of the Upper Valley Allotment, Garfield County, Utah.


Lake
fault
Spring
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Upper
Potato Valley
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Kws
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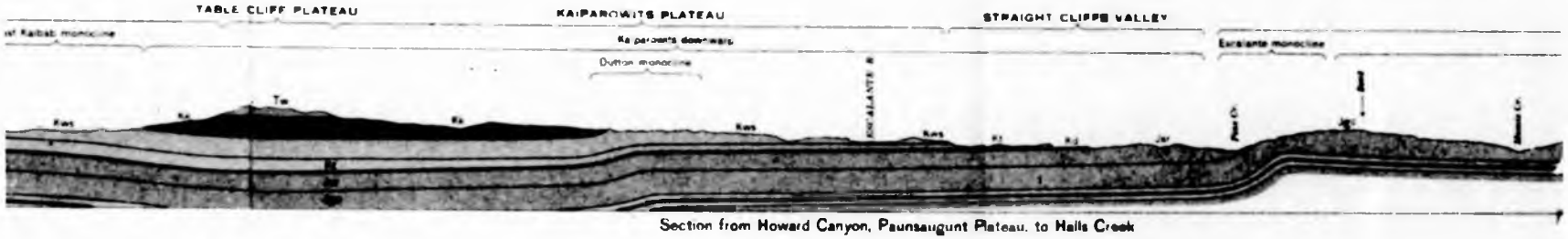
Cannan Peak
Kk
Losee
Creek
Kws
Kd
Ks
Jar
Escalon
Potato
Hendersons
Cannan Draw
Alvey
Our Spring
GOUNTY

Fig. 7. A Profile Section of The Table Cliff Plateau, The Kaiparowits Plateau, and The Straight Cliffs Valley.



Section from Howard Canyon, Paunsaugunt Plateau, to Halls Creek

COTTONWOOD VALLEY

and spruce-fir associations. The soil mantle in this cirque has been greatly disturbed by the forces of erosion because the understory has been continuously grazed by livestock since the arrival of white men. However, the gradient, being upward of 50 per cent, has reduced the grazing potential of this area.

The canyons to the north of this drainage have cut their way through high benchlands of the Left Allen and Right Allen canyon country. The streams in these canyons are not permanent, but because they head in the steep talus outcroppings of the Table Cliff Plateau, they are subjected to devastating run-off after each storm regardless of its intensity (Fig. 8).

The valley is typical of other mountain valleys found in southern Utah, having been developed at a much lower elevation, accumulated a deep soil profile, then been elevated into its present position and remained as a fertile mountain valley until this present cycle of erosion was initiated.

The benchlands fingering into the valley from the north, the west, and the south rise abruptly from the valley floor. These benches are elevated above the neighboring features several times. They are remnants of old river beds which existed during the same periods in which the valley was formed. Much erosion pavement exists on the benches, having left extensive areas devoid of plant cover in the pinyon-juniper associations and also in the ponderosa pine associations.

The plateau which stands as an almost inaccessible escarpment above the benchlands is a result of recent faulting. It is the most prominent feature in the allotment.

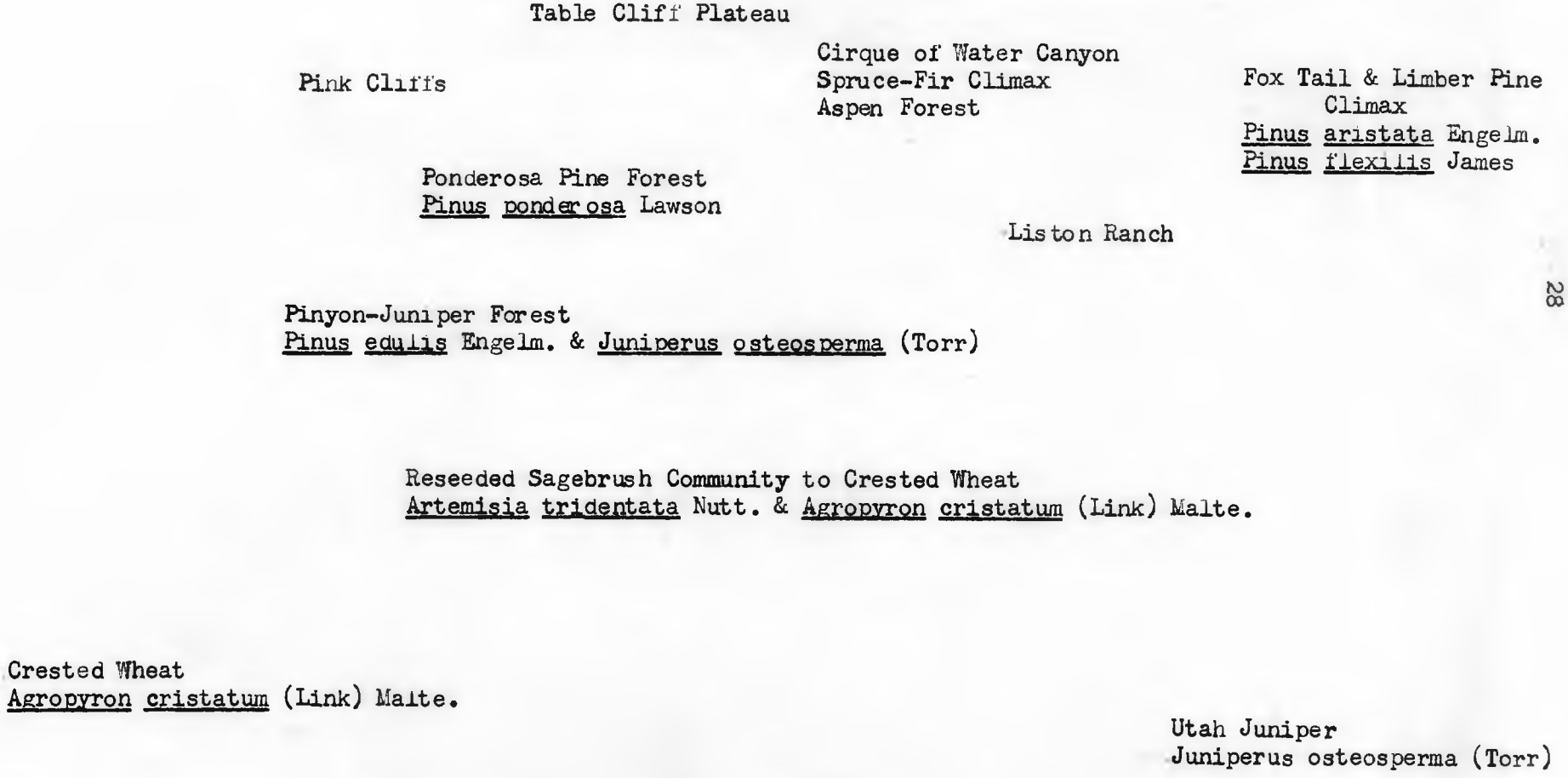


Fig. 8. The Table Cliff Plateau. The foreground shows a part of the reseeded area of the Upper Valley Allotment with young juniper invading the valley.

Climate

The climate in the area over the past hundred years has undergone very little change. There has been seasonal change in temperature, precipitation, humidity, wind intensity and direction, but this pertains to local conditions of the weather rather than to climate. Tree rings of one of the oldest trees found in the area, dating back into the 16th century, show little variations in size except for seasonal precipitation and temperature. No marked variation in climate is indicated in this tree ring study.

Precipitation

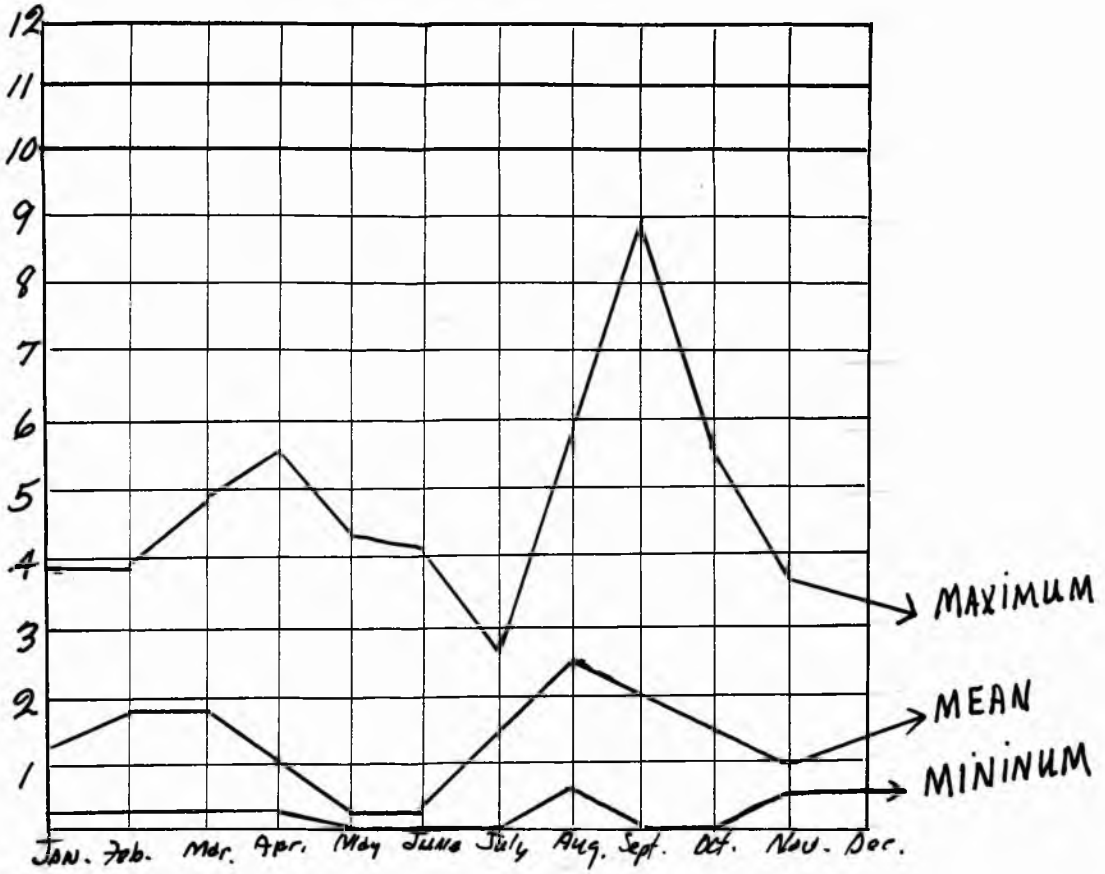
The annual mean precipitation of the Upper Valley Allotment is not available. However, known conditions at Bryce Canyon National Park, approximately 12 air miles directly east and at the same elevation, 8,060 feet, were utilized as a comparison. The precipitation chart will note the annual precipitation at Bryce Canyon from 1935 to 1954. The average annual mean precipitation at Bryce Canyon for these 19 years is 17.3 inches.

The writer concludes from such a comparison that where elevation and location so approximate each other, the annual mean precipitation of the Upper Valley Allotment in the Pinus ponderosa forest is comparable to or exceeds the figure of 17.3 average annual precipitation at Bryce Canyon, and areas elevated above this ponderosa forest receive even greater annual precipitation.

Table 1. Annual Total Precipitation at Bryce Canyon

Year	Annual Total Precipitation
1935	22.95
1936	19.16
1937	19.81
1938	20.86
1939	19.47
1940	20.86
1941	20.41
1942	13.90
1943	16.24
1944	15.15
1945	22.00
1946	23.34
1947	19.62
1948	14.20
1949	19.44
1950	7.25
1951	15.46
1952	18.29
1953	14.47

Table 2. Monthly Precipitation at Bryce Canyon
Maximum, Mean, and Minimum



Temperature

The average maximum temperature at Bryce Canyon National Park, Utah, is 57.1° F., and the average minimum temperature is 24.7° F. The highest temperature recorded is 91° F. This temperature occurred in the months of July and August. The lowest temperature recorded is -21° F. The average dates and length of seasons are as follows: average date of the last killing frost in the spring is June 18; the average date of the first killing frost in the autumn is September 9; the average length of the growing season, last killing frost to first killing frost, is 89 days; the latest date of killing frost in the spring is July 3; the earliest date of killing frost in the autumn is August 4.

Composition of the Soil

Any natural soil is a result of five factors: (1) climate, (2) vegetation, (3) parent material, (4) slope, and (5) age. A difference in any one of these factors, all of which are controlled by climate, will result in a different soil. In the Upper Valley, man, with his herds of sheep and cattle, has greatly altered one of these vital factors so necessary in soil building and soil development. The complete disturbance of the vegetation, factor No. 2 has resulted in an altered soil in the Upper Valley because of reduction in vegetal cover. The characteristics of the soil found in isolated areas relatively free from erosion and disturbance suggests the thousands of years required for this soil to have developed. This mature top soil extended over the entire valley when white man first entered the area. Remnants of this mature soil are found

in many of the drainages entering into the valley (Fig. 9).

The parent materials of the soils in the Upper Valley are lava, sandstone, limestone, and a calcareous shale of the Wasatch Formation. These parent materials are capable of supplying the necessary ingredients from which plant nutrients are derived.

The soil on the uppermost mountain slopes is shallow, but is a mature soil. Higher elevations support wet meadows which have developed rather deep peat and bog soils, some of which are of a depth of 2 feet. These peat and bog soils contain organic material not less than 80 per cent by weight.

The ridges and benchlands at lower elevations show very poor soil development. These soils have been at the mercy of intense erosion, which has removed literally all of the A-horizon from this area, and with the present condition of the vegetation so ravaged and sick, there appears little hope for soil development.

The soil remnant found in the valley suggests a one-time well-developed, deep, sandy-clay loam. According to Dr. Gvozdetsky the development of such a sandy-clay loam requires a maturing process of over hundreds of years (Personal communication).

The arroyo of the valley reveals an excellent profile which shows a successional development of valley fill. This development is broken by three prominent organic depositions which stratify the entire area. The last of these meadows, which were present at the time Jones and Powell entered the Upper Valley, was growing upon a mature soil which had come into equilibrium with its environment. This meadow and soil would have

Micro-climate of
Blue Spruce
Picea pungens Engelm

Ponderosa pine
Pinus ponderosa Lawson

Sagebrush & Rabbit brush Community
Artemisia tridentata Nutt & Chrysothamnus viscidiflorus (Hook) Nutt.

Alluvium Deposited by floods of the 1890's.
Soil that developed in the meadow that was present
at the time Powell and Jones traversed the Upper Valley.

The perpendicular profile of
Right Allen Wash, north-facing exposure.

Fig. 9. Meadow Alluvia Profile. The arroyo at the mouth of Right Allen Canyon pictures the well-developed meadow alluvia.

persisted until today had man utilized it wisely.

The C-horizon of this mature soil is composed of a loose sand and gravel in the upper drainages, and a heavy sand in the valley floor.

The B-horizon is composed of silt, sand and gravel with some organic remains distributed throughout it.

The A-horizon, markedly changed by present erosion, still contains a micro-aggregate rich in organic material not less than 5 per cent and not more than 20 per cent clay (Fig. 10). This A-horizon, 9 to 20 inches deep, is a mature soil with a characteristic profile developed under humidified conditions (Fig. 9).

The sand and gravel of the B-horizon is extremely useful as a porous mantle, allowing excess rainfall which precipitates upon the A-horizon to percolate into the B-horizon rather than to initiate new run-off.

The sandy loam of this area is extremely vulnerable to the slightest erosion force once the litter and vegetation have been removed. The ridges and benchlands of the Upper Valley show extensive erosion pavement with cancerous rills and gullies altering the surface so completely that from one year to the next one has to leave the original trails to thwart these gullies.

The soil in the area is largely basic, ranging from ph 7.83 in a sagebrush association in the head of the valley to ph 9.04 in a greasewood association at the mouth of the valley. Fifteen tests for soil ph were made in the allotment.

Fig. 10. Trenching in a Mountain Valley. A mountain valley near Seep Hollow on the Canaan Mountain depicting soil development and extensive erosion in these valleys.

Table 3. Results of Soil

	Soil Sampled	Reaction with HCL
1.	Two foot layer of dark clay in arroyo 30 feet below surface	+
2.	Two foot layer of laminated pink clay in arroyo 27 feet below surface	+
3.	Four inches deposit of blue clay resting on laminated pink clay	+
4.	Four foot sand layer blue colored, separated by 6 inches red layer under 2 feet of sand	+
5.	Sink hole surface in old meadow	+
6.	Greasewood association in valley	+
7.	Carex association in wet meadow	+
8.	Juncus, top soil, in wet meadow	+
9.	Top soil from wet meadow area	+
10.	Soil under litter beneath ponderosa pine trees	+
11.	Soil beneath Arctostaphalus pungens	+
12.	Soil from thick stand ponderosa pine on high ridge, elevation 8,700 feet	-
13.	Soil from the pink Wasatch formation at elevation of 9,700 feet	+
14.	Soil from Water Canyon 10,000 feet in aspen forest	+
15.	Barney Top, sage flat 10,570 feet	+

Test

Soil ph.	Phosphate in Parts per Million
8.49	Trace
8.52	Trace
8.47	Trace
9.04	Trace
8.69	More than other samples, but still less than 2 p.p.m.
9.07	Almost as much as 5 p.p.m.
8.48	Rare
8.33	Slightly less than 2 p.p.m.
8.31	Slightly less than 2 p.p.m.
7.83	6 p.p.m.
7.87	5 p.p.m.
6.70	Slightly less than 2 p.p.m.
8.72	Trace
7.32	5 p.p.m.
7.13	Less than 2 p.p.m.

The only acid condition discovered in the valley was in the litter among a thick stand of young Pinus ponderosa on a high ridge just north of the present Ranger Station which had a ph. of 6.70. These soils are derived from a limestone parent material which largely contributes to the basic condition of the soil in the allotment. A high evaporation rate in a semi-arid desert also helps contribute to the basic condition of the soil through the accumulation of basic salts on the soil surface. But the accumulation of pine needles rich in tannic and other organic acids produced the acid condition found in the litter of the ponderosa trees.

ARROYO CUTTING--ITS CHARACTER AND CAUSES

Present Erosion Features

The most conspicuous physiographic feature of Upper Valley today is the arroyo system that traverses the entire length of the valley bottoms. The great ugly trench in the main valley floor at the lower, northern end of the valley progressively diminishes as the dendritic branches course their diverse ways from the crest of the ridges in their respective secondary drainage areas. The gully system is almost but not quite complete. Figure 11 depicts well the nature and speed with which one branch of Water Canyon Creek is cutting its gully system toward the upper limits of this drainage area. This picture, taken in the fall of 1952, was filmed a scant 100 yards from the summit of the ridge. The perpendicular nature of the up-stream wall of this arroyo shows that the trenching progresses by slumping and caving of great blocks of earth rather than by gradual cutting. Late in the summer of 1952 the writer observed that in a single thunder shower of less than 1/2 inch of rain and in the interval of less than an hour's time, more than 2 rods were added to the length of this gully system. A ponderosa pine tree 8 inches in diameter slumped into the newly formed 18 foot trench. By the time the flood had subsided, the tons of earth formerly held in this meshwork of roots, a product of thousands of years of soil building, had completely disappeared (Fig. 13).

Storms of much less intensity are devastating to the soil mantle on widespread areas where the plant cover has, in historic times, been ravaged through over-grazing (Fig. 12). During one such storm in the summer of 1952, the writer observed that the rain had barely begun to fall when

tiny shoe-string gullies on benchlands and on ridges with gradients ranging from 20 to 60 degrees became choked with liquid, flowing topsoil. At the bottom of the inclines, these numerous small streams joined forces into a raging flood of major proportions with almost unbelievable power. On the up-hill extremities of the gully systems the slowly moving puddles of water, thickly charged with clay and fine silt through raindrop splash, merged into rills of rapidly flowing mud in previously formed erosion channels. With the carrying power of these racing rivulets magnified 64 times with each doubling of the fluid volume, channels were quickly widened and deepened (Fig. 11). Sand, then gravel, and finally, boulders added their weight to these unleashed forces of resource destruction. Rocks measuring 3 1/2 inches in diameter and weighing 2 pounds 7 ounces were collected at the bottom of a short incline as they raced along the bottom of a small gully eventually to mingle with boulders of larger and larger proportions.

In order to ascertain the soil content of this minor flood, the writer collected a container full of flood water from one of the small gullies south of the Upper Valley Ranger Station. After it had been weighed, the water was allowed to evaporate. The following table gives a good idea of the amount of soil loss from a storm of moderate intensity:

Table 4. Per Centage of Debris Carried in Flood Water

Weight of container-water-flood debris	33 pounds
Weight of water	14 pounds
Weight of debris	12 pounds
Weight of container	7 pounds
Per centage (by weight) of water	56%
Per centage (by weight) of debris	44%

Immature ponderosa pine trees
Pinus ponderosa Lawson

Ponderosa Pine
slumped into upstream arroyo

Characteristic soil and rock mantle
of the benchlands on the Table Cliff
Plateau

Fig. 11. Typical Slumping Features. This is typical of the upstream arroyo system on the Table Cliff Plateau benchlands.

Past Erosion Features

Rapid as the current processes of arroyo-trenching seem to be, they are slow compared with those of a half century ago, chiefly because the system is nearly complete. Topsoil loss in the upper reaches of most of the drainages, of course, continues at an accelerated pace equalling or even surpassing that of the early 1890's, but the deep arroyos of the valley bottoms, in specific areas at least, are gradually being stabilized (Fig. 13). The enormity of soil loss through arroyo-cutting throughout the once rich meadow bottoms of Upper Valley is difficult to comprehend. One must stand on the brink of the perpendicular walls of this mighty soil chasm to realize its dimensions. Even then it is hard to believe that for every linear foot along the arroyo and its tributaries (approximately 15 miles) 1.3 carloads of dark, rich earth, or 6,864 carloads per linear mile, were irretrievably lost directly to the Escalante River, a tributary of the Colorado, in the short interval of 50 years (Fig.2).

Historical Evidence of Past Floods

It would be historically untrue to state that floods in Upper Valley exclusively postdate the white man's settlement. Powell's party in 1872 encountered muddy, swollen streams issuing from two creeks that drain the brilliantly colored, precipitous and poorly vegetated walls of the Table Cliff Plateau that forms the western limits of the Upper Valley Allotment. The party had difficulty crossing the meadow bottoms partly inundated by a June 3 downpour. The Table Cliff Plateau from which this erosive material came is comprised of a formation indentical to that of

Match Stick
Gutierrezia Sarothrae (Pursh)

Lygodesmia spinosa Nutt.

Chrysothamnus viscidiflorus
(Hook) Nutt.

Erosion Pavement

Pedestalled Blue Grama Grass
Bouteloua gracilis (H.B.K.)

Erosion Pavement

Fig. 12. Erosion Pavement and Pedestalled Features. This is characteristic of the loss of topsoil in the sub-montane brush community, Upper Valley Allotment.

Bryce Canyon (The Wasatch Formation) famed for its spectacular topography formed by rapid natural erosion(Fig. 8). This historical report of silt-laden streams in the Upper Valley area three quarters of a century ago is thus important because it supports numerous observations of soil conservationists on the importance of an adequate vegetal cover for the retention of erodable material on steep mountain slopes everywhere. Most significant, however, is the fact that the Upper Valley meadow bottoms received the full impact of run-off from high intensity storms that may have struck the Table Cliff Plateau over thousands of years of time without ever succumbing to arroyo-trenching of the magnitude remotely approaching that found in this area today.

What then was the sequence of events that caused the widespread arroyo cutting present throughout the length of these same valleys today? Indisputable evidence of the nature and conditions of these valley fills throughout the entire history of their deposition is faithfully recorded in the soil profiles of the perpendicular walls of the arroyos themselves. They tell a remarkably constant and consistent story. The last episode of this history is also substantiated by written documents of early explorers and by verbal accounts from men who witnessed these shameful events connected with trenching.

All historical accounts, both written and verbal, substantiate the following facts: first, a lush, productive, wet meadow covered the valley bottoms at the time of settlement in 1875. Second, no vestige of the present arroyo existed at that time. The drainage channels of these valleys were shallow, relatively stabilized and well-vegetated. The story is often told in Escalante that the drainage channel at the north

Fig. 13. Root Network. The exposed roots in the ponderosa pine forest in the upstream arroyo system of the Upper Valley Allotment.

lane, upstream from the present townsite, was spanned by a bridge firmly built on a single strand of logs 12 feet in length. Today, at this same spot, the arroyo reaches a width of approximately 130 yards (Fig. 2). Third, the entire area that comprises the Upper Valley Allotment was grossly over-grazed as was all of the open range of that day, and warnings of great land abuse came within 15 years after settlement in the form of excessive run-off from foothill areas formerly well vegetated. Fourth, disaster came with great suddenness in a series of floods in 1892 that resulted in the abandonment of farms and the burial of most of the meadow land under a variable thickness of erosion debris. Fifth, a series of subsequent floods in rapid succession initiated arroyo-cutting first at the lower end of the valley, and trenching once begun, rapidly fingered its ugly course toward the drainage summits.

The uppermost stratum of the arroyo profile substantiates in general the historical accounts of these events. Significant is the fact that a mud-rock layer of variable depth lies superimposed upon a stratum of meadow-formed soil, indicated by its dark color and uniform deposition. This distinct layer of meadow soil is present throughout the arroyo system of the valley. At the mouth of the valley the old meadow profile lies buried under a mixture of silt, sand and gravel to a depth of only 18 inches, but near the head of the tributary drainages, this superimposed layer is heavily impregnated with boulders, some of which are more than a foot in diameter. Here the flood layer attains a depth of more than 6 feet (Fig. 15). Below the center of the valley, the gradient diminishes perceptibly from that of the southern, upper area, and this fact together

with the greater distance from the flood source accounts for the reduced thickness of the flood debris as well as for the decrease in the size of the soil particles transported to the lower, northern segment of the valley. Thus the arroyo profiles support the historical evidence that the initial floods of Upper Valley, descending from the steep and overgrazed slopes that surround it, fanned out across the valley and deposited their loads of debris before cutting the 206 foot-wide chasm that so effectively drains the entire valley today (Fig. 14).

Rather precise evidence on the date of the first violent floods as well as the period of time required for the establishment of the major arroyo system was gathered in the spring of 1953 from a tree ring study of borings from ponderosa pines found growing in the flood path near the head of Pine Hollow. One venerable old tree, approximately 2 feet in diameter that stands near the sloping edge of a deep arroyo, was found to have the lower portion of its trunk buried to a depth of 72 inches with flood debris. Figure 15 depicts well the nature and depth of the flood deposition as well as the trenching methods employed to secure the data. A sharp decrease in the annual growth increment was observed to have occurred in the wood of this tree in the year 1892, a date that corresponds precisely with the historical accounts of the initial disastrous floods.

Growing on this flood debris less than 50 yards from the old pine is one tree whose base characteristics of the trunk show it to have sprouted on top of the flood deposit. The age of this tree proved to be 43 years. Since there is no evidence of flood deposits around the trunk of this young tree despite the many torrential floods known to have surged through

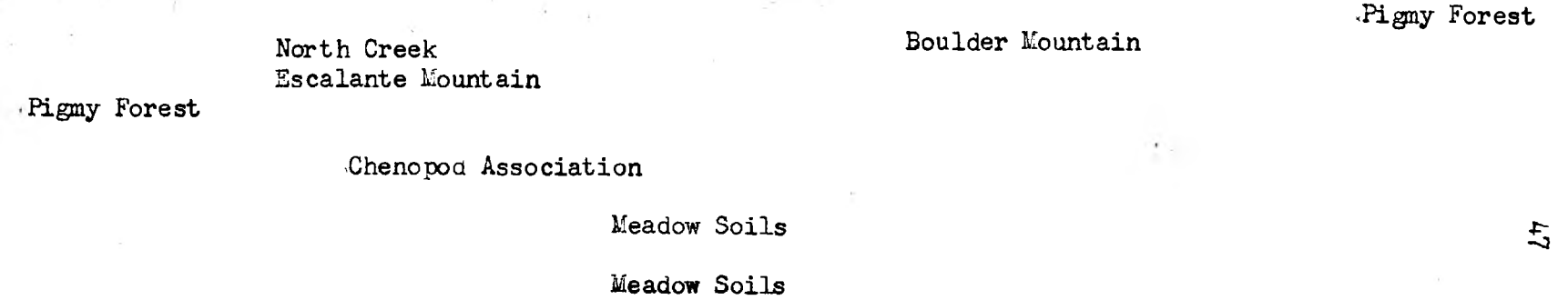


Fig. 14. The Main Arroyo. This arroyo has been trenched to an average depth of 39 feet and an average width of 69 feet in the Upper Valley Allotment.

the arroyo system during its life span, it must be assumed that trenching, sufficient to accommodate the largest floods, had been attained by the time the tree was a seedling. This means that the period of time required to establish the present arroyo system could not have exceeded 18 years, and it is probable that it was accomplished in much less time. Porter, Heaps and Griffin all stated that the trenching in Upper Valley was completed substantially as it appears today in the early 1900's (Standing, 1935).

A study of the exposed arroyo profiles in the great soil chasms of Upper Valley gives an impressive story of the time involved in the accumulation of the valley fill and of the cyclic nature of its deposition. That there have been previous periods of accelerated erosion is established beyond doubt. Three extensive epochs of meadow development are clearly recorded. The first of these meadow strata appears near the bottom of the profile. It has a thickness of approximately 40 inches compared with 9 inches of an organic stratum that was developed by the meadow extant in pioneer days and with a second organic layer of 18 inches that lies midway between the two. Dr. Vasyl Gvozdetsky, an authority on soil and soil development, of the Department of Geography of the University of Utah, who kindly spent two days with the writer studying the arroyo system of Upper Valley, suggested that the first meadow persisted for a period of not less than 6,000 years and perhaps for as long as 10,000 years (Fig. 14). The other two distinct periods of meadow development occupied a proportional epoch of time. All meadow strata are similar in the fine textured nature of the soil colored dark with the completely decayed organic

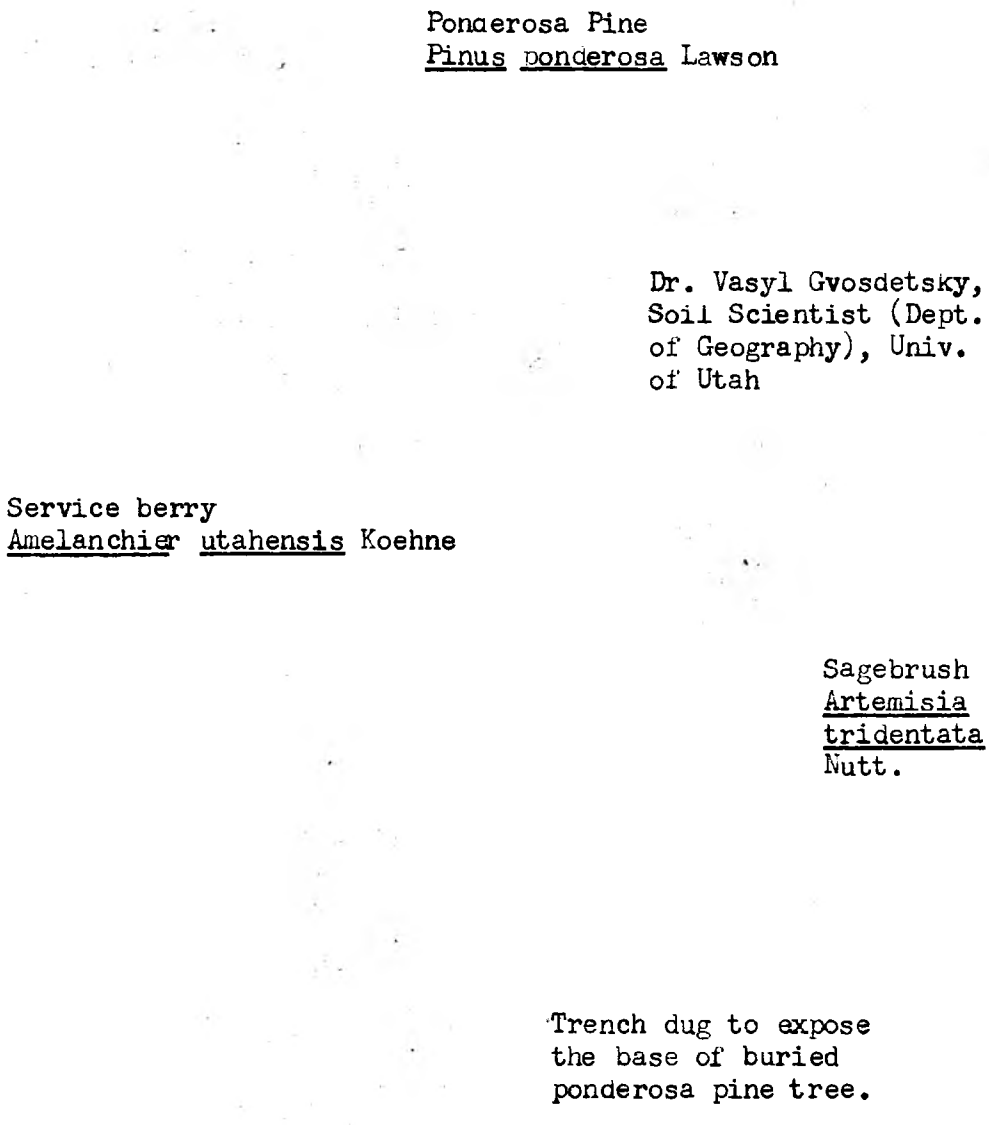


Fig. 15. Flood Debris. The flood debris was deposited about the base of the ponderosa pine tree to a height of 72 inches in 1892.

remains of ages. These strata represent quiescent periods of time when moisture was abundant and continuous and when a good cover of vegetation on the upper drainage areas effectively prevented excessive siltation.

But the superposition of extensive coarse alluvial deposits, poor in organic content, over all of these meadow strata attest to sudden and more or less violent response of the upland soils to a change in the character of run-off. Resting upon this first meadow stratum is a succession of alluvial deposits measuring 8 to 10 feet in thickness. The stratum immediately above the organic layer represents gravel material of large size followed by successive layers of sand, silt and finally clay. These facts suggest periods of accelerated erosion of decreasing violence marking a gradual recovery that finally ended in a new meadow establishment and a near cessation of siltation. The new meadow, like the one preceding it, was developed over a relatively long period of favorable growing conditions when the vegetal cover of this area remained in a state of effective equilibrium with its environment. The period of rapid alluviation, despite its depth, may have been of relatively short duration, judging from the character of the material deposited and from the enormous deposition of debris during the few years of the present erosion cycle.

The second period of rapid alluviation increased the valley fill to an additional depth of from 6 to 7 feet. The details of its story as recorded in the soil profile are essentially repetitious of the first erosion cycle described above (Fig. 14).

The factors responsible for these past periods of rapid alluviation are not definitely known, but man could not have been an agent in the process as he most certainly was during the current period of accelerated erosion.

Increased gradients of the drainage area and significant changes in climate such as drought accompanied by widespread fire are possible causes suggested to explain these evident erosion cycles, but whatever the causes, they were obviously different from those initiating the present erosion cycle, and the consequences were vastly different. Firstly, no such accumulation of mud-rock flows characterized the previous epochs of alluviation, and secondly, no channeling remotely comparable to the present arroyo system ever developed throughout the valley bottoms. For if such trenching had ever occurred, cross sections of these buried soil chasms most assuredly would be evident in the present arroyo system (Fig. 14).

With such a vast trenching system so firmly established in Upper Valley, it is difficult to visualize any probable rehabilitation measures of either man or Nature likely to erase the disgraceful consequences of land abuse within a period of time to be measured by hundreds of generations of human lives. Little comfort can be found in the fact that the same generation that brought such catastrophe to this once fertile valley, lived to reap the poverty of their folly--but people in more favorably situated areas could, if they would, learn valuable lessons of land management that might ultimately save them from a similar fate.

PLANT COMMUNITIES AND SUCCESSION IN UPPER VALLEY

A prominent feature of the Upper Valley Allotment is the zonal aspect of vegetational communities. The nature and response of individual plant communities are determined by variable environmental factors, including those of topography, climate, soil and biotic. The ability of any given species to survive in a community may be and often is determined by the minimal requirements for any one factor of the environmental complex. Evidence seems to support the conclusions that each species within the community varies in its minimal and maximal response to a host of interacting environmental factors. The precise distribution of the various component species may differ markedly. Therefore, the concept of plant communities as used in this paper is restricted to the distributional status of the conspicuous dominants.

Figure 16 should be referred to with reference to the plant associations discussed in this chapter. The writer examined a cross-section of the allotment from the Canaan peaks to the valley floor, hence up the lofty escarpment to the summit of the Table Cliff Plateau which gave a true perspective of plant communities and present plant succession within the communities which will be discussed in the following order. The plant communities are:

Table 5. Plant Communities

Communities	Elevation
1. Wet meadow	5,700 - 6,000 feet
2. Dry meadow	6,000 - 6,600 feet
3. Sub-montane brush	6,600 - 7,000 feet
4. Pigmy forest	6,000 - 7,700 feet
5. Ponderosa pine forest	7,700 - 8,500 feet
6. Mid-montane brush association	8,000 - 8,700 feet
7. Upper-montane forest	8,700 -10,577 feet

Fig. 16. Plant Communities. A graphic illustration of the plant communities on the north-facing slope of the Canaan Mountain and the south-facing slope of the Table Cliff Plateau of the Upper Valley Allotment.

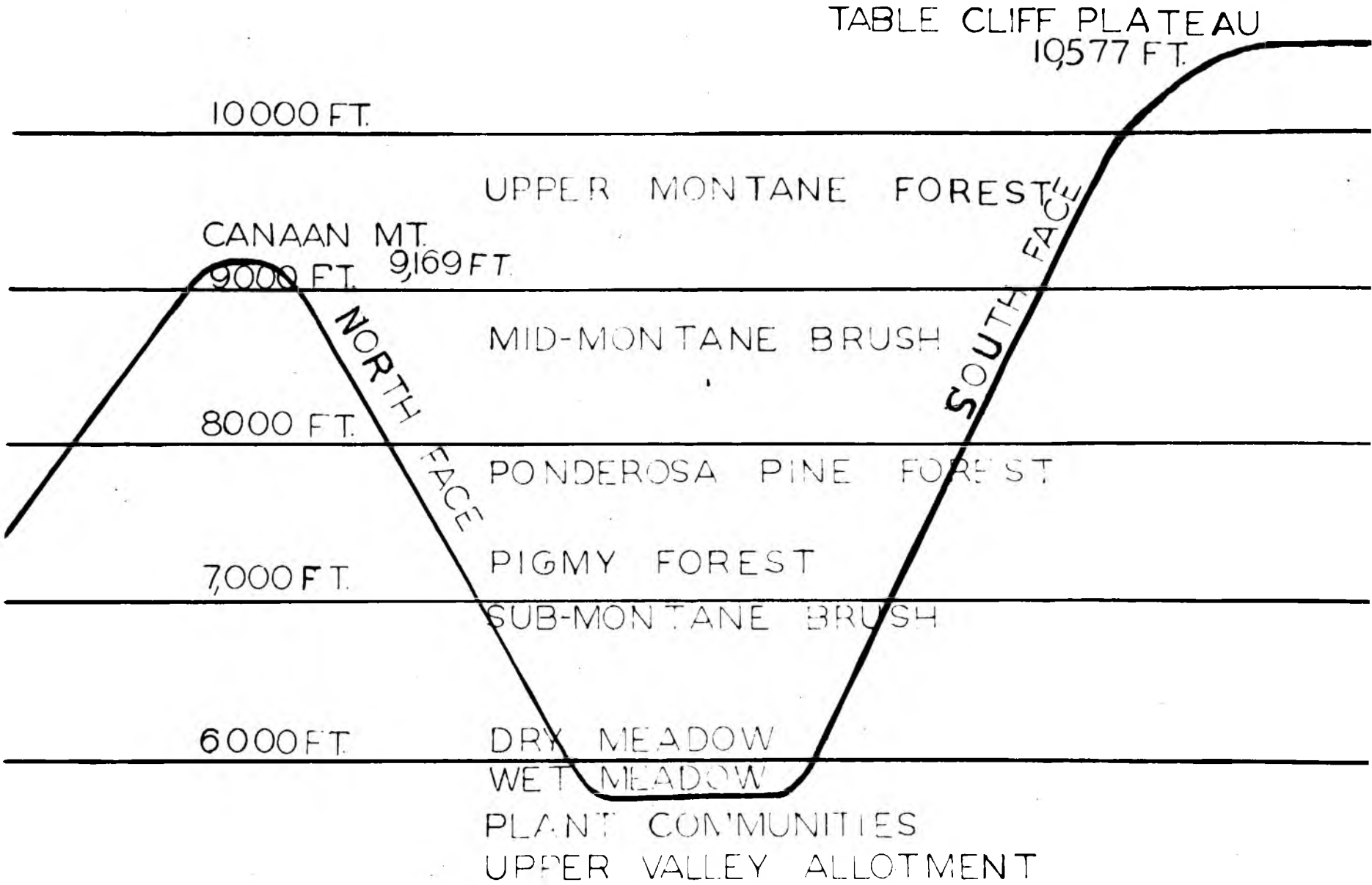


TABLE CLIFF PLATEAU
10,577 FT.
10000 FT.
UPPER MONTANE FOREST
CANAAN MT.
9000 FT. 9,169 FT.
MID-MONTANE BRUSH
NORTH FACE
SOUTH FACE
8000 FT.
PONDEROSA PINE FOREST
PIGMY FOREST
7,000 FT.
SUB-MONTANE BRUSH
6000 FT.
DRY MEADOW
WET MEADOW
PLANT COMMUNITIES
UPPER VALLEY ALLOTMENT

The grass covered valley entered by Jones and Powell in 1872 has now been drained, eroded, and completely altered in many aspects of soil profile, soil chemistry, and plant communities. No doubt many of the same plant species exist in the present wet meadow and neighboring areas that grew there at the time Powell's survey party camped at the meadow springs in June of 1872. However, change in density of plant cover, composition, plant vigor, and plant succession has certainly occurred because of extended grazing pressure upon these plant communities. Evidence is abundant to support the conclusion that in pioneer times Upper Valley was predominantly grassy, comprised of both wet and dry meadows. The dry meadows occupied the upland valley fringes of good drainage now dominated by a sagebrush community while the wet meadow covered the lower elevations of the valley of poor drainage and abundant water supply. Much of the former wet meadow is now dominated largely by a chenopod association.

Wet Meadow

Approximately 20 acres of the wet meadow land remains today on the Liston Ranch as a remnant of the once lush and extensive bottom meadow Fig. 4). Fortunately this furnishes an opportunity to determine the dominant species that existed in this hydric association before such environmental changes occurred. Much of this meadow was cultivated and planted to grains and alfalfa. The more swampy area was used for pasture land as it is today. This previously cultivated land has been abandoned, and now supports a new and different plant community--mostly rabbit brush

and greasewood. However, occupying the deeper peat bog soil of the meadow is an abundance of Carex, Juncus, Eleocharis, and Scirpus species, with Carex agrostoides Machenz, and Juncus balticus Willd., Juncus saximontanus A. Nels, and Eleocharis palustris (L) R and S most abundant. In the meadow where the stream meanders and deep water collects, perpetuating a swampy condition, a dense cover of meadow plants still persists of which these species appear most frequent: Carex petasata Dewey, Carex aquatilis Wahl, Carex nebraskensis Dewey, Juncus ensifolius Wikstr., Deschampsia caespitosa (L), and Scirpus acutus Muhl, Along the stream where the water runs clear and deep three submergent forms appear: Cicuta Douglasii (DC), Coult. and Rose, Barbarea orthoceras Ledeb. and Chara spp. Other plants found in the meadow but less frequent were Companula parryi Gray, Triglochin maritima L., Iris missouriensis Nutt., Plantago eriopoda Torr., Aplopappus lanceolatus (Hook) Torr. and Gray, Erigeron lonchophyllus Hook, Dodecatheon radicatum Green, Ranunculus sceleratus L. Sacaton, Phlox longifolia Nutt. Occupying the better drained parts of the meadow and along the streams within the present arroyos the following species are very common: Smilacina racemosa (L) Desf., Salix exigua Nutt., Equisetum arvense L., and Asclepias speciosa Torr. Most of these meadow species are heavily utilized as pasture for cattle.

The present meadow species that occupy the periphery of the wet meadow, the accumulation of organic deposition upon the valley floor, and statements made by such early settlers as Alvey, Heaps, and Spencer, describing the previous boundaries of the wet meadow, leads one to conclude that great plant succession has occurred in the valley since the turn of the century.

This once wet meadow is now so eroded and drained that it has been invaded by dry meadow complex of grasses and chenopod communities reaching a mature edaphic climax in this area. Distichlis stricta (Torr.) sods the turf between the rills and gullies. This grass, characteristid of Utah's salt deserts, has invaded this once wet meadow environment. Other grass species found in this dry meadow are Sporobolus airoides Torr., Sporobolus contractus Hitche, Sporobolus cryptandrus (Torr.) A. Gray, Muhlenbergia squarrosa Scribn, Muhlenbergia pungens Thurb., all of which show some degree of abuse.

Dry Meadow

Merging with the dry meadow and at its margins, two relatively salt tolerant chenopods occur: Sarcobatus vermiculatus (Hook) Torr., and Atriplex confertifolia (Torr. and Frem.). The former forms an edaphic climax on heavy, poorly drained and alkali soils of the Great Basin deserts. Sarcobatus is very salt tolerant and is found growing in the Upper Valley in the pans and depressions where salts have collected on the soil surfaces. Sarcobatus is also an indicator of a high water table. Therefore the writer concludes that the habitat of this association in the Upper Valley, even though deeply trenched and drained, has available water ponded in this heavy clay soil from which this community derives its water.

The Atriplex is found on areas elevated and better drained. They are represented by mature stands, some of which, at the outer fringes, are closely associated with the Artemisia tridentata. There are 3,000 acres of the once wet meadow now dominated by the chenopod associations.

The soil of this chenopod community is, in general, composed of a

heavy clay containing much alkali. A ph as great as 9.7 was discovered. This ph value is considered very high for soils. Kellog suggests that soils having a ph of 10 are very rare. The area occupied by the chenopod community was a wet meadow only three quarters of a century ago. The periodical flooding of this wet meadow, plus the generally swampy condition resulted in a dilution of the salt concentration and much of the alkali forming salts were continually washed away, resulting in a lower hydrogen ion concentration. It is fair to assume that the old wet meadow had a hydrogen concentration similar to that of the present wet meadow which is still relatively high in hydroxyl ions with a ph of 8.3.

Sub-Montane Brush Association

Skirting the dry meadow and chenopod communities in areas better drained and slightly higher in elevation, a sub-montane brush association now occupies the remaining 2,500 acres of the valley floor. These gentle slopes are covered with rich, deep soils, and in pioneer days supported a dry meadow grass type. This brush association composed chiefly of Artemisia tridentata Nutt., and Chrysothamnus viscidiflorus (Hook) Nutt., represent recent invasion into this grass covered valley. The grasses were rapidly depleted in the valley as a result of over-grazing and less palatable species soon migrated onto this denuded land. Cottam and Stewart (40,618,620) found a similar situation at Mountain Meadow in Southern Utah. They say, "Once the grass is eradicated it is soon replaced by sagebrush," which spreads onto the denuded areas. Other species in this brush association are Artemisia frigida Willd., Artemisia dracunculoides Pursh., Artemisia nova A. Wells, Tetradymia canescens DC., Chrysothamnus teretifolius (Dur.

and Hilgard) H.M. Hall, which represent in part the brush forms that compose this sub-montane brush association. Flanking the meadow to the north and west where the soil is much coarser in texture, a rather dense brush association appears. Shepherdia argentea Pursh, Nutt., Salix exigua Nutt., and Rosa Fendleri Crepin, are the dominants of this association. Many herbaceous forms appear annually in both the dry meadow and sub-montane brush association. They include the following:

Abronia pumila Rydb.
Achillea lanulosa Nutt.
Allium acuminatum Hook
Antennaria aprica Greene
Antirrhinum Nuttallianum Benth.
Apocynum cannabinum L.
Arnica cordifolia Hook
Aster crassulus Blake
Astragalus Thompsonae Wats
Baileya multiradiata Harv. and Gray
Baileya pleniradiata Hook and Gray
Calochortus Nuttallii Torr. and Gray
Castilleja chromosa A. Nels
Cirsium lanceolatum L. Hill
Erigeron concinnus (Hook and Arn.) Torr. and Gray
Erigeron lonchophyllus Hook
Erigeron racemosum Nutt.
Erigeron umbellatum Torr.
Gilia aggregata Pursh.
Gilia aggregata var. Arizonica Pursh.
Gilia congifolia Nutt.
Helianthus ciliaris DC.
Helianthus nuttallii Torr. and Gray
Hymenopappus lugens Greene
Hymenoxys acaulis (Pursh) K.F. Parker var.
    Arizonica (Greene) Parker
Lepidium Fremontii S. Wats
Lesquerella intermedia (S. Wats) Heller
Lygodesmia spinosa Nutt.
Oenothera caespitosa Nutt. var. Marginata (Nutt) Mury
Oenothera caespitosa Nutt.
Oenthera pallida Lindl. Britton
Opuntia polyacantha How
Penstemon Eatoni Gray
Penstemon Rydbergii A. Nels
Penstemon utahensis Eastn.

Phlox longifolia Nutt.
Potentilla crinita Gray
Psilostrophi sparsiflora Gray, A. Nels
Salsola Kali L.
Senecio multilobatus Torr. and Gray
Sidalcea neo-mexicana Gray
Yucca baccata Torr.

These herbaceous forms dot the interspace and exposed areas between the grass and brush plants. Many of them are widely dispersed through the valley and bench lands. At lower elevations on the east and south facing slopes of the Canaan Mountain are found two wooded species, uncommon in other parts of the allotment's sub-montane brush association. They are Fraxinus anomala Torr., S. Wats, the single leaf ash, and Ephedra viridis Coville, commonly known as Brigham tea. These two plants inhabit the dry sandy hillsides and sandy flats of the western most extension of the Kaiparowits Plateau.

The acreage once cultivated and utilized as farm land, now abandoned, is dominated by two brush species which represent recent invasion into these cultivated areas. The two species are rabbit-brush and matchweld.

Pinyon-Juniper Forest Association

The woodland, usually designated as "pigmy forest" consists of a mixture of scrub trees of various sizes and degrees of maturity comprised essentially of two dominant trees, Juniperus osteosperma (Torr.) Little, the Utah juniper, and Pinus edulis Engelm., the two-leafed pinyon. At Upper Valley this forest is confined principally to the benchland and foothill between 5,000 and 7,000 feet elevation. The boundaries of the pigmy forest are rather sharply defined at both the lower and upper altitudinal limits, but the elevation of the forest depends on the direction

of the particular slopes on which it occurs. Junipers and pinyons are well adapted to the warm, dry slopes and mesas of shallow but well drained soils. No elevation in the Upper Valley area is low enough to approach the hot temperature limits of the pigmy forest, hence the lower distribution of juniper and pine before the influence of the white man was primarily determined by competitive influences of grass which abounded on the deep, rich soils of the valley bottoms. This conclusion is adequately supported by historical events of grazing in this area. With the reduction of grass competition by heavy livestock use, the upland grassy fringes of the valley were quickly invaded by sagebrush and these in turn are rapidly being invaded by juniper. This observation of juniper invasion into former grassland types is widespread throughout much of Utah (Cottam and Woodbury, 1940).

The upper extensions of the juniper-pinyon forest seem definitely to be limited by temperature. The highest elevation in the Upper Valley Allotment to be dominated by the pigmy forest is found on the warm mesa of the Kaiparowits Plateau where it dominates the landscape at 8,000 feet. Elsewhere, however, the type seldom exceeds 7,000 feet and on the north-facing slopes it rarely exceeds 6,000 feet (Fig. 8).

At the upper limits of its distribution the pigmy forest is in active competition with ponderosa pine and mid-montane shrub types. Here, as at the lower areas of distribution, overgrazing has altered the competitive status in favor of the juniper but not to the same degree. Both pinyon and juniper have extended their range in historical times upward as well as downward, but the upward extension is considerably less in degree. It seems reasonably certain that in prehistoric times, the mountain shrubs

Ponderosa Pine Trees
Pinus ponderosa Engelm.

Pigmy forest invading
ponderosa pine forest.

Utah juniper
Juniperus osteosperma
(Torr)

Utah Juniper
Juniperus osteosperma (Torr)

Spanish Dagger
Yucca baccata Torr.

Erosion pavement
Hedged bitterbrush Purshia tridentata Pursh
Spanish Dagger
Yucca baccata Torr.

Fig. 17. Upper Limits of Pigmy Forest. Mature ponderosa pine forest is being invaded by Pinus edulis Engelm. and Juniperus osteosperma (Torr.) on the benchlands of the Table Cliff Plateau.

formed a narrow belt between the pigmy forest and the ponderosa pine. With the reduction of vigor of the shrubs through overstocking the pigmy forest invaded upward and the ponderosa pines were equally effective in extending their range downward so that today the seedlings of both these forest types are vigorously intermingled (Fig. 17).

Unlike the extensive grass types that occupied the entire valley floor in pioneer days, the pigmy forest is noted for its discontinuity. The reason for this, of course, is the great topographical diversity of the foothill area which it dominates. Differences in soil character and in microclimates provide local areas within the belt where shrub and even ponderosa pine communities are found that pretty generally excluded juniper and pinyon preceding white man's influences.

Several notable features characterize the mature pigmy forest. As mentioned earlier, it thrives on shallow rocky soils. The root systems are thus necessarily shallow and they are extremely extensive, far surpassing the crown diameters of the individual trees. Consequently root competition must be great which accounts for the generally widespacing of the trees. Observations here support Woodbury's report of a pigmy forest in Garfield County, Utah, where the crown of one juniper tree measured 24 feet in diameter while its exposed root system measured 80 feet in diameter (Woodbury, 1947).

Of great economic concern is the fact that the pigmy forest supports a sparse understory of vegetation. The extensive root system of the forest trees, the low water-holding capacity of rocky, shallow soil on which they grow, and low amount of moisture that precipitates at these elevations are certainly not conducive to a rich, subordinate flora. Shrub species of high

palatability to livestock that are frequently encountered in the juniper-pinyon forest include: Amelanchier utahensis Koehne, Artemisia nova A. Nels, Ceanothus Fendleri Gray, Cowania mexicana D. Don., Purshia tridentata Nutt., and Symphoricarpos oreophilus Gray. Most of the herbaceous plants listed for the marginal brush type are found in the juniper belt, and shrubs of low palatability such as Chrysothamnus teretifolius (Dur. and Hilgard) H. M. Hall, and Tetradymia canescens D.C. are quite common.

Juniper and pinyon foliage are practically unpalatable to domestic livestock, and with scant undercover in the type at its best, it can be easily understood why the palatable forage of the pigmy forest has suffered severely through overstocking of the Upper Valley range. Serviceberry, cliff rose and bitterbrush have been particularly damaged and nearly exterminated. Reproduction of these species is almost entirely absent and their forms are so malformed through continual browsing that they are hardly recognizable. Figure 21 illustrates this fact well. The bitterbrush, Purshia tridentata Nutt., has developed a prostrate growing habit, absent of layering characteristic suggested by McNulty (1947). "Bitterbrush is a semi-erect, diffusely branched deciduous shrub," whereas the bitterbrush of the Upper Valley area are growing in a prone condition.

A line transect of 1,000 yards was used to sample bitterbrush plants for current growth, plant vigor and reproduction. More than 67 per cent of the current growth had been utilized. Of the 217 individual plants sampled, 97 of these plants were more than 50 per cent dead, and all plants showed low vigor. This transect was conducted in the summer of 1950. That year adequate moisture had precipitated in the area for good forage production, but because these browse plants are so sparse in the pinyon-juniper

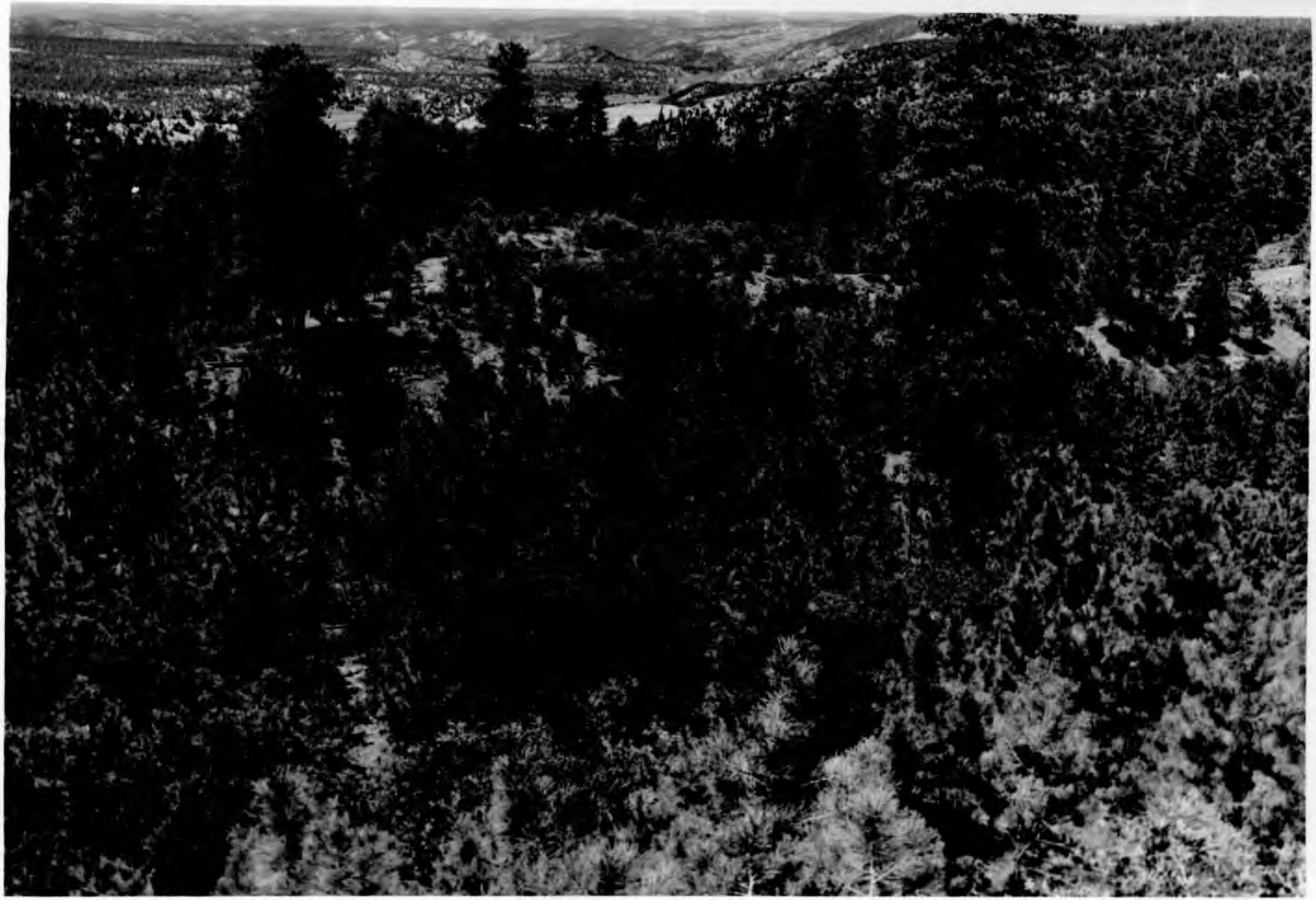
forest they receive the full impact of the grazing stock in the early spring.

Ponderosa Pine Forest Association

The ponderosa pine (Pinus ponderosa Lawson) reaches extensive communities of climax status in the Upper Valley Allotment at elevations between 7,500 and 8,500 feet. Mature forests are populated with enormous trees with an average height of 80 to 100 feet (Fig. 18). Their trunks breast high range from 18 to 40 inches in diameter and are generally devoid of branches to a considerable height, making these trees extremely valuable as a source for lumber. Though widely spaced, the crowns of trees of a mature stand often intermingle their branches to form a dense canopy of shade under which a very sparse undercover of shrubs and herbs are found.

The forest floor of mature ponderosa pine stands is notably lacking in subordinate vegetation for several reasons, in which the water factor operates either directly or indirectly. First, precipitation, though adequate to produce trees of large dimensions, is insufficient to produce an excess of moisture necessary for the development of an undercover. Second, dense shade undoubtedly would prevent any invasion of sun-requiring species, but on the other hand, this should encourage the development of shade loving forms which it does not do. This fact supports the statement above that the pine root competition for the limited supply of moisture and not shade is by far the most important factor in understory barrenness. Third, the soil of the ponderosa pine forest is notably shallow, poorly developed and generally low in phosphates (less than 6 parts per million). Fourth, deep accumulation of pine needles are always found beneath the crowns and generally over the entire forest floor, sometimes reaching depths of

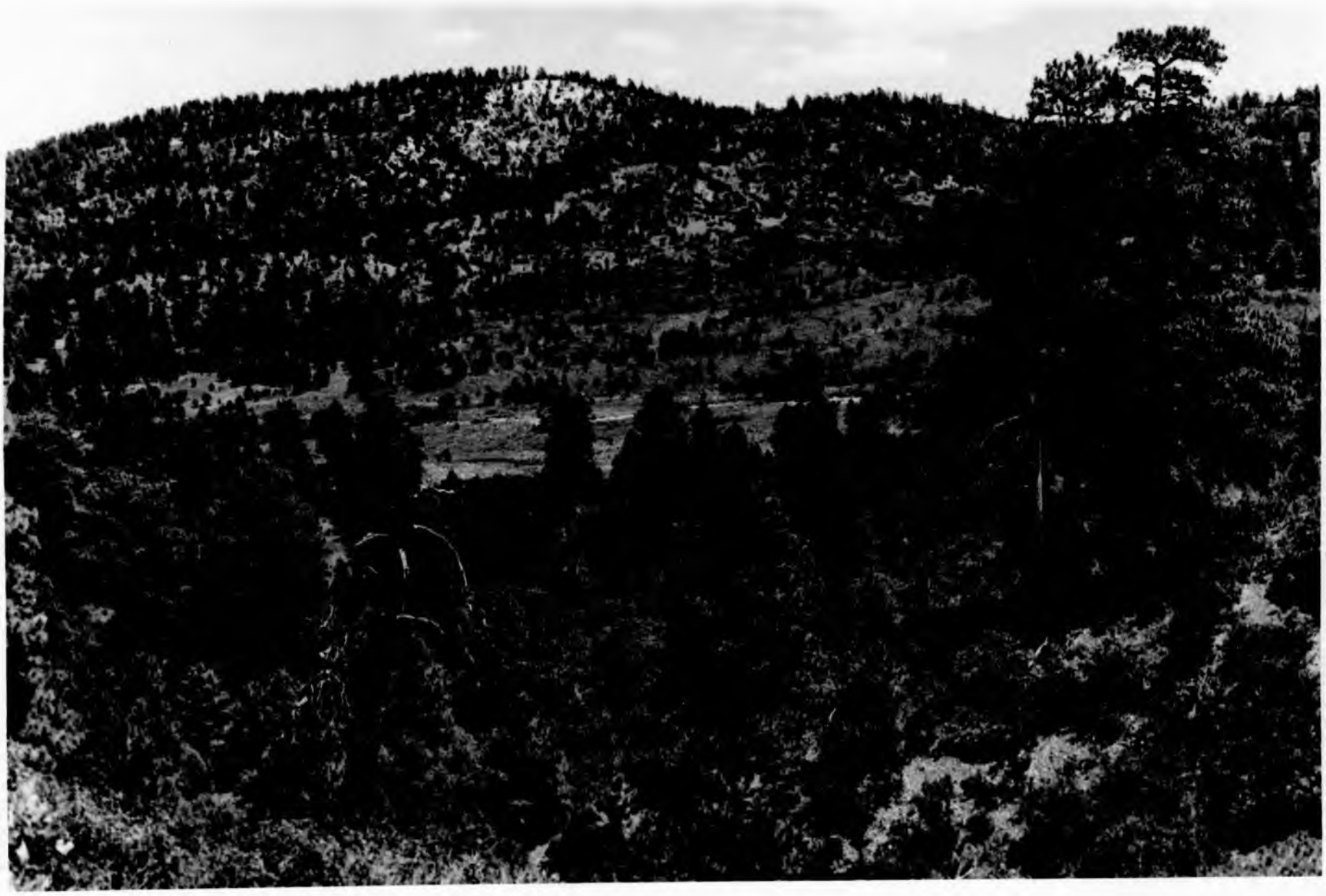
Fig. 18. Ponderosa Pine Invasion. Immature ponderosa pine forest is extending its range into the upper-montane brush association on the north-facing slope of the Canaan Mountain.



several inches and seeds find great difficulty to germinate and to establish themselves in the mineral soil so far below the surface. Fifth, the needles of pine are notoriously rich in tannic and other organic acids. The only soil found to show an acid reaction in the entire Upper Valley Allotment appeared under the litter of ponderosa pines. Whether the acid released during decay processes is sufficient to affect germination of seeds is problematical, but a definite possibility.

Ponderosa pine, like the juniper-pinyon forest at lower elevations, show excessive reproduction in cut-over areas and in the narrow belt of mountain brush that probably separated them in pioneer days from the pigmy forests below. Almost clean cutting, practiced by the pioneer loggers who left an occasional inadvertent tree that served admirably well as a seed source, plus evidence of fire, are factors sufficient to explain this reproduction on the sites of the former mature stands; but they fail to explain the narrow belt of medium aged trees of a single age stand that occupies a distinct line below the old forest. No stumps are found here, and the hedged remnants of mountain shrubs still present in this belt lends credence to the theory that these trees represent a sudden invasion into a mountain brush type as a result of excessive grazing. Below this single aged stand of ponderosa pine approximately 60 years old, numerous seedling ponderosa pine may be seen mingling with the seedling junipers and pinyon as described earlier. Thus, in that portion of the Upper Valley area occupied by ponderosa pine forests accessible to the grazing of livestock and to the settler's axe, three distinct age classes of trees are clearly evident: (1) very old and mature trees evidently remnants of the original

Fig. 19. Valley Invasion by Ponderosa Pine Trees. An immature ponderosa pine forest is extending its range into the valley tributaries of the Canaan Mountain.



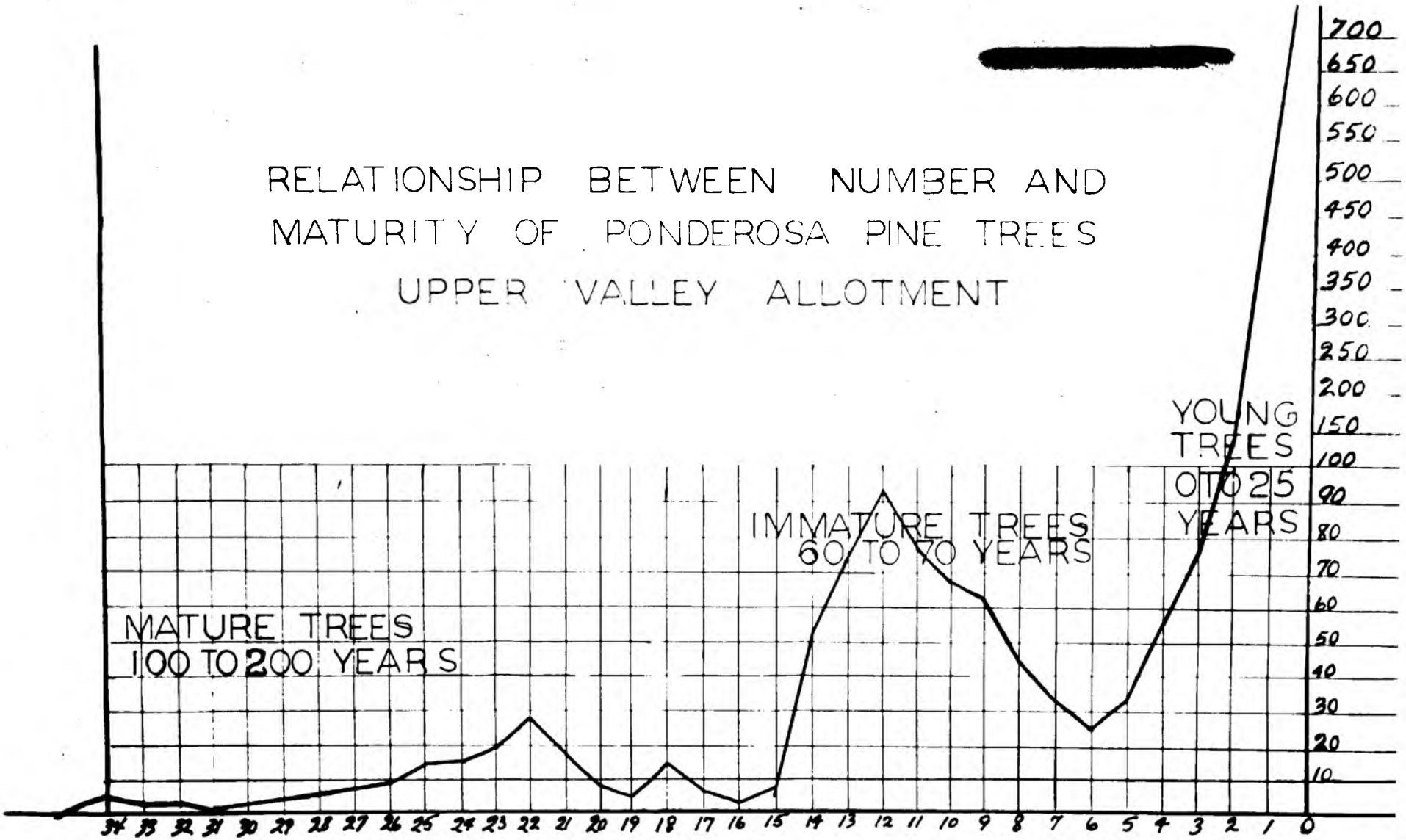
forest, (2) a belt of immature trees whose tree borings show them to have germinated in the late 1880's and 1890's, and (3) a vigorous crop of seedlings rapidly expanding into the invading zone of the juniper and pinyon of the lower foothills (Fig. 20).

In order to ascertain the age classes of the ponderosa pine population throughout that portion of the belt thus modified by human exploitation, a series of belt transects were used in a quantitative survey. By means of numerous increment borings the relation of trunk diameter to age was determined. Page 68 gives the detailed figures of these transect studies.

The actual number of acres in which this young ponderosa pine forest has invaded was not determined. However, there are 23 square miles of the Allotment supporting ponderosa forest. This was determined from aerial photographs of the Allotment. The relationship between the number of small trees 5 inches in diameter (746: 1-23 years) as compared to mature trees 24 to 28 inches in diameter (8:100-300 years) vividly illustrates a population increase of 93.2 per cent. Figure 18 pictures the density of this invading population and suggests that extensive browse acreage will be eventually dominated by a ponderosa forest. Forests of this nature may directly affect and even change the economy of the people. For all these years they have utilized the range to graze their stock, but with a species such as ponderosa occupying the area, it is inevitable that great forage production can never again be attained. The sad fact is that this forest will not be ready for harvest until the turn of a new century (Fig. 18).

Associated with the young ponderosa forest are mature browse species. They are rare and some badly hedged, showing varied degrees of use and

Fig. 20. Relationship between Number and Maturity of Ponderosa Pine Trees in the Upper Valley Allotment.


RELATIONSHIP BETWEEN NUMBER AND
MATURITY OF PONDEROSA PINE TREES
UPPER VALLEY ALLOTMENT
MATURE TREES
100 TO 200 YEARS
IMMATURE TREES
60 TO 70 YEARS
YOUNG
TREES
0 TO 25
YEARS
700
650
600
550
500
450
400
350
300
250
200
150
100
90
80
70
60
50
40
30
20
10
34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

stabilization. Such species as Purshia tridentata, Artemisia tridentata, Chrysothamnus vicidiflorii, Cowania neo-mexicana, Sambucus melanolasius, Tetradymia canescens, Amelanchier oreophila, Symphoricarpos oreophilis, Gutierrezia Sarothrae and Arctostaphylos pungens compose the principal, scattered understory of this ponderosa forest.

Mid-Montane Brush Association

This browse forage was and still is a significant vegetation within the allotment so far as grazing is concerned. Historically this association composed of oak, Quercus gambelii Gray; serviceberry, Amelanchier oreophila Gray; bitterbrush, Purshia tridentata (Pursh.) D.C.; cliff rose, Cowania mexicana D. Don; squaw bush, Rhus trilobata Nutt.; elderberry, Sambucus microbotrys Rydb; mountain mahogany, Cercocarpus ledifolius Nutt; and Cerlocarpus montanus Raf.; buck brush, Ceanothus Fendleri Gray, and buck thorn, Rhamnus betulaefolia Greene, marked dense thickets on both mountains. These browse species comprising a palatability rating of not less than 78 per cent have been heavily grazed and they have received the full impact of both grazing stock and wild game during the past 75 years. Figure 5 illustrates some of this abuse and pictures stems of oak and cliff rose hedged back to diameters of 3/4 inch on these mature plants.

The brush community extends its boundaries into both neighboring belts of the ponderosa pine and the aspen-fir of the upper-montane forest. The writer considers this mid-montane brush association as a complex of many species, none of which is dominant except in restricted micro-environments on both mountains.

Fig. 21. Mature Stands of Oak. Mature stands of Quercus Gambelii Nutt being invaded by young ponderosa pine trees on the northwest-facing slope of the Canaan Mountain.

Nowhere in this mid-montane brush association were these plants reproducing themselves with abundance. Figure 21 pictures mature, hedged, stands of oak (Quercus gambelii Nutt.) with no signs of reproduction and young ponderosa pine invading the oak stands. The small plants are eaten as rapidly as they push their way into this environment. The soil litter in this community has been largely destroyed so that the bare earth does not lend itself well to germination of these browse plant seeds which require a well developed litter for germination and establishment of young plants.

Upper Montane Forest Communities

On the more humid slopes and plateaus of the higher elevations of the Upper Valley Allotment is the Upper Montane Forest occupying approximately 1/5 of the Allotment's total area. Due to such factors as use, successional status, microclimates, slope and soil conditions, and altitude, four rather distinct forest types are recognized: (1) the pure aspen stands, (2) the mixed spruce-fir communities, (3) the sub-alpine spruce forest, and (4) the foxtail pine-limber pine type. In general, the forest communities listed above occur at progressively higher elevations. They will be discussed in the order listed.

The Aspen Forests

At Upper Valley, the aspen seldom form dominant forest communities below 8,500 feet in elevation and, with few exceptions, only at their lower limits are they found in pure stands. The generally high precipitation requirements of this tree are seldom met below 8,500 feet, and the aspen therefore replaces at such altitudes the thick montane brush type of the lower elevations.

Important in understanding the aspen-conifer forest relationship are several facts of aspen ecology. In the first place, the aspen never reach the status of a climatic climax because they are intolerant to their own shade as well as to that of the spruce-fir which normally replaces them in biotic succession. The blue spruce, white fir, and Douglas fir, on the other hand, all of which are found to dominate the climax communities of the aspen belt, are, in general, unable to tolerate full sunlight. The aspen may be regarded, therefore, as nurse trees or as subclimax dominants in this forest succession. Within the aspen belt, the climax forest of spruce-fir, if properly managed, always show upon careful examination the unpretentious remnants of aspen suckers ready to perform their successional role should disaster in the form of fire, snowslides, disease or the axe, strike the stabilized forest.

Another significant fact of aspen ecology in Utah today is that the aspen reproduction is limited entirely to vegetative means. It is believed that when climate was more favorable at the close of the last glacial period, aspen became distributed throughout their present forest areas by means of seed. However, as conditions became less favorable for seed germination and establishment, reproduction became more and more dependent on suckering from the aspen roots. The roots of these trees sprout vigorously in all ages up to 110 years. But because of the fact that aspen forests, in their developmental stages, are intolerant of shade, some catastrophe such as fire, initiated the development and as a consequence, an aspen stand of whatever age always comprises trees of nearly the same diameter.

The time required for the reestablishment of the spruce-fir forest after a catastrophe such as fire, depends on many factors; the proximity

of the seed source, the degree of damage to the surface organic layer, on favorable years of seed production, on proper conditions for seedling establishment, and perhaps many others--so that the life time of several generations of aspen may pass before the stand is ultimately replaced by climax conifers. But regardless of this time factor, the trees of the aspen forest seem never to lose their prevailing character of a single aged stand. The reason seems to be that if the saplings begin their initial forest growth at the same time, they likewise grow old together, die and the waiting, retarded suckers once more spring forth for their place in the sun.

In the light of this discussion on aspen ecology the position and character of aspen forests in the Upper Valley area seem meaningful because the near pure stands are found, in general, on areas most accessible to livestock while those showing definite succession toward the climax are confined to remote or inaccessible habitats. On Canaan Mountain, for example, mature stands, widely dispersed, are found on all suitable exposures. The groves exhibit limited sucker reproduction and the top soil is badly eroded and sparsely vegetated. Aspen sprouts are moderately palatable to both livestock and deer. There are far too many of both in this area and the aspen sprouts are consumed for want of other forage. In addition, many of the aspen groves are situated in positions with respect to water holes that they receive the full impact of grazing pressures throughout the growing season. As a consequence forage plants are over utilized, aspen sprouts are hard to find, the surface soil is deprived of adequate cover and accelerated erosion is rampant. Trenched gullies measuring 12 to 15 feet in width and fully as deep, are frequently encountered. Great blocks of earth sometimes 200 square feet in extent and supporting as many

as four to six aspen trees frequently slump into these actively eroding trenches.

In contrast to the above, other aspen forests more favorably situated with respect to moisture and to grazing pressures, particularly on higher north-facing slopes remote from livestock concentrations or on areas relatively inaccessible to grazing animals, show differences in reproduction in forage amounts and in successional status of conifers that are difficult to believe without seeing them. Here aspen suckers are abundant; the undercover forage is lush, and saplings of the normal climax conifers are very much in evidence. The Douglas fir is particularly aggressive here and the writer experienced great difficulty in riding his mount through some of these aspen forests. Grass species forming dense cover in such places include: Agrostis alba L., Bromus carinatus Hook and Arn., Calamagrostis canadensis Michx., Calamagrostis inexpansa A. Gray, Festuca ovina L., Phleum alpinum L., and Poa pratensis L. Calamagrostis canadensis carpets this forest in large areas with a density cover of 90 per cent and the litter accumulation is 3 or more inches deep. With such protection both in plant and litter cover there is no surface erosion. Such areas remain in near pristine conditions because man and his herds of sheep and cattle have found this forest inaccessible to grazing.

That aspen forests, like the large plant communities below them, have suffered great damage through excessive grazing use is a fact beyond dispute. To predict what will ultimately happen from continued misuse is dangerous, at least in detail, but it is reasonable to assume the continued interference of its peculiar method of vegetative reproduction might precipitate disastrous consequences and soon. If the aspen forests

are allowed to attain final senility without adequate protection of the sprouts on which regeneration of the stand depends, there is imminent danger of widespread, sudden and final destruction of aspen forests on overstocked ranges. What biological chain reaction such an eventuality might precipitate no one can predict with certainty, but the probabilities are that it would be of serious consequences in the climax succession of the lower spruce-fir forests.

This much is certain,-with the loss of aspen forests of the Upper Valley area, considerable natural beauty will have perished forever, for the trees here are among the noblest specimens to be found in Utah. Some reach diameters of 38 inches and they grow to heights of 90 feet. These sizes are extreme however. The average diameters approximate 12 inches and their heights average 50 to 60 feet.

Mixed Spruce-Fir Forests

In the high, humid mountains of central and northern Utah, the spruce-fir belt though ecologically similar throughout is generally more or less sharply separated into two rather distinct forest zones. According to Merriam's classification, these are the Canadian Zone dominated by blue spruce (Picea pungens Engelm.) and white fir (Abies concolor (Gordon and Glendenning) Hoopes.) and the Hudsonian Zone where Engelmann spruce (Picea Engelmanni Parry) and the alpine fir (Abies lasiocarpa (Hook) Nutt.) are the conifer dominants. At Upper Valley however these belts are not apparent. The reason seems to be that due to moisture deficiencies the generally higher elevations of the spruce-fir in the Escalante region has so narrowed the belt that general intermixing of all these forest species is the rule. On the Canaan Mountain, the most northerly peak of the Kai-

parowits Plateau with an elevation of a little over 9,000 feet, there are no conifers of the Hudsonian Zone, and the blue spruce and white fir are restricted to favorable areas of the north-facing slopes. On the Table Cliff Plateau at the west limits of the Allotment where elevations exceeding 10,500 feet are reached, pronounced, dense stands of spruce-fir abound on all slopes with good soil above 9,500 feet (Fig. 8).

At the head of Water Canyon, a great amphitheatre or cirque, approximately 2 miles wide, well protected from the prevailing southwest winds, relatively well watered and gentle sloped, is found the finest expression of the mixed spruce-fir forest. Several such cirques are seen on the east face of the Table Cliff Plateau (Fig. 8). So great is the contrast between the bold, highly colored, barren projections of the Table Cliffs from the deep blue, densely forested slopes of these alternating cirques that the latter are locally called the "black timber". Here Engelmann Spruce, alpine fir, and Douglas fir (Pseudotsuga taxifolia (Poir) Britton) are the chief components of a thick, mature forest with a well vegetated understory of herbaceous plants. The trees reach immense proportions for this area. Douglas fir 40 inches in diameter and more than 100 feet tall are not uncommon. Such luxuriance on these few square miles of high forest land indicate not only exceptional growing conditions but an area too remote and inaccessible to have suffered over exploitation by man, a rare situation for Upper Valley.

Associated with these three dominant species throughout the high forest of the cirque, aspen, blue spruce, white fir, limber pine (Pinus flexilis James), and foxtail pine (Pinus aristata Engelm.) appear as widely scattered subordinate species.

The narrow canyons of the Table Cliff Plateau and Canaan Mountain where small perennial streams drain into the valley below, cool microclimates permit many species to extend their range downward into the lower altitudinal zones. Confined to a narrow belt along the streamsides, the blue spruce and white fir reach elevations as low as 7,500 feet where they mingle freely with such species as dogwood (Cornus stolonifera Michx), river birch (Betula fontinalis Sarg.) and aspen. Farther downstream the narrow leafed cottonwood (Populus angustifolia James), the big-toothed maple (Acer grandidentatum Nutt.) and the box elder (Acer Negundo L.) and the yellow mountain willow (Salix lutea Nutt.) form the chief streamside trees.

Sub-alpine Spruce Savannah

The Alpine Savannah found on the Wasatch Plateau of central Utah and in the Uinta Mountains of northern Utah support scattered discontinuous colonies of Alpine fir and Engelmann spruce. The high plateaus of Table Cliff and the nearby Aquarius are notably different in that the Engelmann spruce alone survives at 10,500 feet and above. The savannah character of Table Cliff and the Aquarius, however, are ecologically similar to the other plateaus mentioned, but taxonomically the grassy parking areas there are dominated by a single grass, Festuca ovina, excepting in the wet meadow.

The broken talus slopes of the Table Cliff Plateau support two pine species, Pinus aristata Engelm. and Pinus flexilis James. The fox tail pine inhabits the very impoverished, depleted rock mantle of the wind swept slopes, at elevations of 9,000 feet and above on Table Cliff Plateau. Found among this climax are subordinates of Shepherdia canadensis L. Nutt. and Holodiscus dumosus (Nutt) Heller, the latter forming rather dense

stands in better developed soil. Two grass species, Elymus salinus and Calamagrostis scopulorum, are common on the open slopes associated with the two browse types. Pinus flexilis James was also found scattered throughout the spruce-fir forest and at the periphery of the forest. It also inhabits the steep talus slopes of the Table Cliff Plateau as does the fox tail pine.

THE CONSEQUENCES OF LAND ABUSE AND POSSIBILITIES OF REHABILITATION

It is an incredible thought that only 80 years ago Powell, with his survey party, camped in a valley supporting a lush meadow and rode through benchlands and foothills upon which grew a predominance of desert grasses. The sight of this same land today is appalling even to the casual observer.

The settlement of Escalante was a part of the expansion into southern Utah by the early Mormon pioneers. These pioneers obsessed with misconceived ideas of unlimited abundance of forage for their livestock and water for their arable land, did not perceive that these lands and their products could be destroyed. Their main interest was to reap the harvest that Nature had planted for them without considering what effect the increasing number of sheep and cattle would eventually have upon this harvest. Such a misguided philosophy, that land so productive and rich in available forage would ever diminish to non-productivity, was as ironical as it was sad. The impact wrought by the uncontrolled and mismanaged herds of sheep and cattle, as well as the shameful waste of timber, was vividly realized by the settlers within two decades after the settlement of Escalante. The initial floods, devastating and uncontrollable, descended upon their privately owned land, ripped open irrigation canals, destroyed dams, trenched and deposited debris on the cultivated fields rendering them sterile. These floods raging through the valleys left trenches of a magnitude rarely unsurpassed in any other part of the state. Such early destruction to the land was believed, by these early pioneers, to be acts of God, punishing them for moral sins committed.

The rich, sandy, clay loams of these valleys were well suited for cultivation of alfalfa and grain. The yields were great and pleasing to

these early pioneers. The writer's father, Horace R. Hall, recalls the time when the alfalfa growing on his father's ranch, the Hall ranch in Main Canyon, "grew to a height of an average man's arm pits." From this statement the writer concludes that the alfalfa grew to a height approximately 4 1/2 feet. Mr. Hall said, "the harvest of an average yield was 6 ton to the acre." Such high yields further substantiate the productivity of these virgin soils cultivated by the early pioneers of this settlement; and too, it bears out the economic loss to the community resulting from the floods that might never have occurred had there been proper regulations established at the onset of this range deterioration. The science of ecology and range management, being in its infancy, had little available information which could have informed these people had they thought it necessary to seek help. It is obvious that they would not have thought it necessary, because no reduction in livestock occurred in the area until the U. S. Forest Service placed limits on the number of sheep and cattle allowed on any one range. These restrictions were unjust in the thinking of many men who still failed to realize the true cause of the catastrophe. They continued to trespass the forest range with large herds of cattle and sheep. The stories are still being told by cattle and sheep men in Escalante of how they outsmarted the rangers and turned their animals onto the forest preserve without having permit rights to do so. Attitudes of this nature towards controls or regulations of any kind are common among most of the cattle and sheep men of Escalante today. Objective thinking by men who reap their livelihood from the grazing resource would seem to be a prime necessity, but evidence of the lack of it is demonstrated by disrespect, distrust, and even rebellion against suggestions made by forest personnel.

The forest personnel, adequately trained in the science of forestry and range management, has two prime objectives: first, to manage forest lands for the good of the greatest number of people; second, to help Nature in this gigantic task of rehabilitating a sick land. These objectives must be accepted and supported by all citizens in the community before any form of agricultural resource rehabilitation is possible.

Escalante was settled and to the present time was maintained strictly under an agricultural economy. The foregoing pages have been concerned with the impact of the white man on the agricultural resources: on the range, on the cultivated crops, and on the water and soil on which all forms of use depend. The story written upon this deteriorated and eroded land is not a pretty one, but before discussing some of the possible rehabilitory measures that should and must be adopted if the community of Escalante is to survive, it would seem proper to outline briefly the impact that deteriorated agricultural resources has had upon the lives and the fortunes of the people living in the community.

A most significant consequence of land abuse always is reflected in the economic impoverishment of its people who depend on an agricultural economy. Such impoverishment is illustrated by the number of people who are receiving direct sustenance from federal, state, and church welfare. There were 908 people living in Escalante, Utah in 1950. One hundred sixty nine of those people were receiving direct sustenance from one of the welfare sources mentioned. This amounts to 17.6 per cent of the population on public relief, or approximately one in every five persons dependent on public support. Many of these people are capable of working if work were available.

To further illustrate the progressive decline in the community's agricultural economy some striking figures are available.

Table 6. Relationship between Livestock Numbers and Population of the Community

Year	Population	Cattle	Sheep	Dairy Cows Estimated from Verbal Accounts	Average Stock per Person
1900	723	20,000	45,000	1,500	91
1925	1,010	9,500	33,000	640	43
1950	908	3,370	7,000	228	12

At the turn of the century the number of sheep and cattle in the community seemed sufficient to have provided the average family enough revenue for a comfortable living. The correctness of this assumption is supported by the many new homes and farm buildings that were constructed at that time, some costing several thousand dollars. Men of Escalante boasted of their wealth in the early 1900's and contended that the community was as prosperous as any in the State. But less than a quarter of a century later the impact of abused ranges on the economy of the people can be judged by the number of livestock reductions demanded by the U. S. Forest Service Management. In 1925 the number of sheep grazing the open ranges had been reduced from 45,000 to 33,000 head (about 1/3) and the number of cattle from 20,000 to 9,500 (about 1/2) of the 1900 figure. At this date only 640 milk cows were owned by all the families of Escalante, a probable figure of less than 1/2 that of 1900.

Even with these great reductions in livestock numbers, in 1923 the total cash income from the sale of all livestock owned by the people of Escalante amounted to $586,500.00 or an average of $6,665.00 per family.

But more difficult times lay ahead. By 1945 the total range cattle owned by the people had been reduced to 3,370 head, a mere 10 per cent of the number owned in 1900. By 1950 the number of sheep had been reduced to 7,000 head, a reduction of 85 per cent from the 1900 figure. Dairy stock had likewise fallen to 228, approximately 85 per cent during the same length of time.

Fully as significant as the reduction in livestock numbers was the trend in livestock ownership. In 1900 practically all families owned livestock that grazed the open range. In 1950 all sheep were owned by five families, and although 58 persons owned range cattle, seven persons held the large majority of available permit rights to graze the national forest land.

Problems of Rehabilitation

The decline in population of Escalante, Utah since 1923 seems proof enough that the problems of rehabilitation there are, to say the least, discouraging. If the people are to continue to call this community "Home" certain basic concerns must be recognized and an intelligent community action program must be adopted. The prime opportunities for agricultural rehabilitation lie in: (1) improvement in range and soil; (2) better timber management, and (3) a re-examination of the agricultural potentialities of the area.

Improvement in Range and Soil

What can be done with a land so depleted in vegetal cover and wasted from accelerated erosion? Can this land ever be restored to a productivity

equaling that the pioneers found only three fourths of a century ago? The answer is obviously no! It will take many generations before even part of the loss in soil and plant cover can be restored. The error essentially involved too many cattle and sheep grazing too long on too small an acreage and in the wrong seasons of the year. The seriousness of the error must be recognized by all members of the community if they are to continue to survive from an agricultural resource. To stabilize the vegetal cover and arrest this loss of top soil is of a prime necessity. The only possible method to rehabilitate the grazing resources is to reduce the number of sheep and cattle to that equaling the carrying capacity of the range. Grazing on the area must be secondary to water and soil conservation. The high humid islands of the plateaus must be allowed to develop upon their surface an accumulation of litter and humus sufficient to absorb all precipitation that falls there. With this consideration given first attention there are ways in which men can be very important in aiding nature in a gigantic task of rehabilitating this area: (1) reseeding; (2) contour trenching and upstream planting; (3) better cooperation with the forest personnel.

Reseeding. Reseeding of the sub-montane brush association, where sagebrush and rabbitbrush are dominant, has been most successful in many areas in southern Utah such as Pine Valley, Johns Valley on the East Fork of the Sevier River. In Upper Valley, in the fall of 1938, 1200 acres of the brush association were fenced and heavily disked to remove the brush and prepare the ground for reseeding. This was done by the U. S. Forest Service as a demonstration project. The areas reseeded are located at the head of the valley in the vicinity of Pole Springs, Dead Mare Wash

and Pine Hollow, west of the Tom Spencer Ranch and in valley tributaries south east of the road leading to the oil drillings in Upper Valley (Fig. 8). Fall rains of 1938 were favorable for seed germination (total rain that year was 20.86) and a successful stand of Agropyron cristatum L. was established. Livestock were excluded from the reseeded areas for two years and the crested wheat grass became well established. In the fall of 1940 the U. S. Forest Service Management allowed 1,200 head of cattle to graze the reseeded enclosures until proper utilization had been attained. Thereafter each fall the carrying capacity was carefully estimated and these pastures have been managed on a sustained yield basis.

Such a management practice seems sound and necessary. The writer observed striking differences in forage quantity of the crested wheat grass during four consecutive summers of this study. Samples taken of the wheat grass in the month of August gave reason enough why this area cannot support the same number of cattle each year without consideration of seasonal precipitation on forage production.

Table 7. Sample Values in Crested Wheat Grass

Year	Yearly Total Precipitation	Weight in Pounds per Acre	Grass Height in Inches	Head Length of Grass in Inches
1950	7.25	2,000	37	4 1/2
1951	15.46	208	6 1/2	2
1952	18.29	388	13 1/2	2
1953	14.47	378	11 1/2	2 1/2
1954	6.56	665	23 1/2	3 1/2

The winter snows of 1949 and 1950 precipitated an unusual amount of moisture throughout the State. At Bryce Canyon, as shown earlier, 19.44 inches of moisture fell in the year of 1949. From this figure the writer

concludes that a similar amount of moisture or more precipitated in the Upper Valley that same year. Though 1950 was a drier year than the previous one, late deep winter snows fell in the Upper Valley. The writer was in the Upper Valley in April of that year and at this late date a sheet of snow blanketed the entire floor with an average depth of 5 3/4 inches. This quantity of moisture, plus the lag effect of the heavy precipitation of 1949, made possible the high yield of 2,000 pounds of forage per acre during the summer of 1950. In 1951, however, a forage production of only 208 pounds was produced per acre by the crested wheat. The winter of 1950 and 1951 was extremely dry with a total precipitation of only 7.25 inches, the lowest total precipitation in the past twenty-five years. The effect of this precipitation upon forage production is vividly illustrated in the previous table.

These findings are extremely significant because they support the contentions of ecologists and range managers that stocking of a range must be consistent with the current forage produced. The data further suggests that the actual number of stock which should be allowed to graze the area can be predicted from precipitation values of the preceding year.

The reseeded pastures in comparison with the low forage value of the sagebrush land emphasize the potentiality of the remaining 6,000 acres of brush land in the Upper Valley if it were but fenced, reseeded and properly utilized (Fig. 23).

The total carrying capacity of the 67 square miles of the Allotment before the 1,200 acres were reseeded was estimated by the Forest Ranger to be 3,800 animal months or 920 head of cattle for 4 months. When the 1,200 acres of the reseeded land reached full production in 1947 the carrying

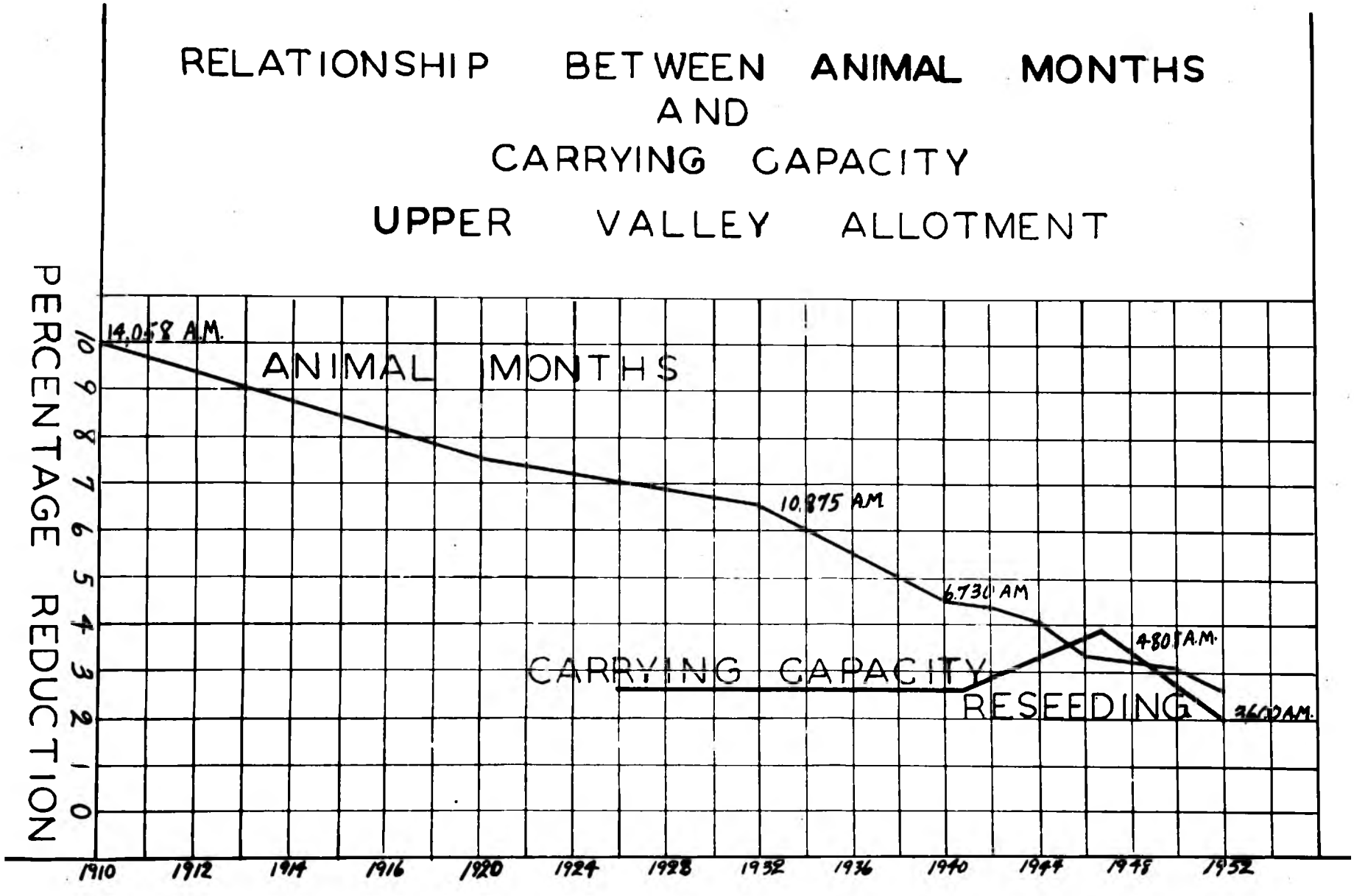
capacity was computed to be 4,808 animal months. Thus the rehabilitation of 4 per cent of the land area of the Allotment increased the estimated forage by 26.3 per cent. During this same period it was later discovered that the forage yield of the non-reseeded range had actually decreased. (Fig. 22).

The area, fenced and reseeded, shows marked recovery of many native grass species particularly of the bunch type. Grasses such as Agropyron trachycaulum (Link) Malti., Agropyron Smithi Ruff., Agropyron spicatum Scribn., Agropyron dasystachyum Hook Scribn., Stipa lettermani Vasey, and Stipa comata Trim and Rupp., which were rarely found in any of the photo transect plots taken in the allotment but are commonly present among the crested wheat of the reseeded enclosures. Therefore it must be concluded that these native grass species are so heavily utilized that they are not reproducing or even sustaining life outside the reseeded enclosures. Oryzopsis hymenoides (Roem and Schult) Richa., Sitanion Hystrix Nutt. and Bouteloua gracilis (H.B.K.) all express more abundance in both the reseeded enclosure and non-reseeded parts of the allotment.

The writer observed that the crested wheat grass was not spreading into the spaced areas between the furrows as was anticipated by the Forest Service at time of planting. However, native grasses are filling in areas between the furrows and sodding these naked areas. It was further noted that most of the original crested wheat grass clusters remain and show high vigor. Figure 23 pictures the vigor of the plants and the current growth of the grass in the month of August of 1952.

The 1,200 acres of the crested wheat was planted by the U. S. Forest Service to demonstrate the potential forage production of these sagebrush

Fig. 22. Relationship between Animal Months and Carrying Capacity in the Upper Valley Allotment in 1952.


RELATIONSHIP BETWEEN ANIMAL MONTHS
AND
CARRYING CAPACITY
UPPER VALLEY ALLOTMENT
PERCENTAGE REDUCTION
0
1
2
3
4
5
6
7
8
9
10
14,058 A.M.
ANIMAL MONTHS
10,875 AM
6,730 AM
4,801 A.M.
3,600 AM.
CARRYING CAPACITY
RESEEDING
1910
1912
1914
1916
1920
1924
1928
1932
1936
1940
1944
1948
1952

Ponderosa Pine Trees
Pinus ponderosa Lawson

Sagebrush
Artemisia tridentata Nutt.

Fence constructed for management of reseeded area where proper utilization of crested wheat grass can be maintained.

Crested Wheat Grass
Agropyron cristatum (Link) Malte.

Fig. 23. Reseeded Area with Crested Wheat Grass. A section of the reseeded area of the Upper Valley Allotment adjoining a non-reseeded sagebrush area.

areas and valley margins. This experimental area has produced an average yearly yield of 727 pounds per acre. This high yield has been the major factor in sustaining present carrying capacity of the Allotment. The U. S. Forest Service offered their equipment to reseed private land if the owners would furnish the material and men to do the job, but despite all of these factors so important to the economy of these stockmen, not a single acre of private land has been reseeded in the Upper Valley Allotment as of today.

Other artificial measures should be initiated to control upstream run-off. The placing of dams, which could be constructed from rocks and fallen timber could serve two functions: first, to help control run-off and up-stream siltation; second, to provide watering holes for cattle and sheep, which in turn would reduce the trampling of forage plants in the vicinity of heavily used stock trails.

Another consideration which is known by all stock men and practiced by some, is the significance of building a pedigreed herd of cattle. Cattle which are properly bred, utilize no more and perhaps not as much feed as cattle of inferior breeds. There are regulations to the effect that bulls which are turned onto the forest must be pedigreed. However, many of the cattle grazing the Allotment are of both milk stock and range cattle. The interbreeding of these two types will produce inferior beef stock. The dollar value of inferior breeds of steers, even though they utilize as much forage as good breeds, is only about two thirds that of the pedigreed steers. This points out the opportunity of good breeds of livestock in helping to solve the present serious range problems.

Contour Trenching and Upstream Planting. There are areas within the Allotment which if contour plowed would aid in arresting soil loss

and run-off. Canaan Bottoms, South Hollow, Seep Hollow, and the Squealer, all of which are scarred with recent erosion, could be contoured and planted with grass to further arrest run-off and soil loss in these areas (Fig. 10).

Planting grasses in the mid-montane brush and aspen-spruce communities has been successful on the Manti Mountains in the Manti LaSal National Forest. To employ such artificial measures seems necessary and would be feasible in the aspen and montane brush communities of the Upper Valley Allotment.

Accepting and Supporting Controls Made by Forest Personnel. When a forest ranger recommends that a range remain ungrazed until the forage has reached maturity sufficient to develop and maintain itself, he is not concerned with the forage of the current growing season entirely, but also with the forage production of the following seasons. Therefore controls on grazing of sheep and cattle on a given range is necessary. The recommendations made by the forest ranger must be accepted and supported by the sheep and cattle men of the community if the vegetation of the range is to produce a yield sufficient for a given number of cattle throughout a grazing season. Unless a range can be managed by methods which are proven by experimentation, then there remains little hope for restoration of an eroded and denuded land.

Timber Management

In the previous chapter Plant Communities and Succession in Upper Valley it was pointed out that 23 square miles of the Upper Valley Allotment are forested by yellow pine. Figure 20 pictures the relationship between mature, immature, and young trees which gives a ratio of young, immature, and mature trees of 116:8:1. This illustrates well the number of young

trees found in the ponderosa forest. The reasons for this increase in ponderosa population are noted in this same chapter. With the young trees so numerous, forming dense stands in many areas, some measures of timber management should be employed. The mature trees should be harvested. The shrubby, twisted, inferior young trees should be removed so as to provide sunlight, soil and water constituents necessary for the growth and development of vigorous young trees. Many of the young trees in densely forested areas could be selectively cropped and utilized as poles, mine timbers or even fence posts if chemically treated. Cropping of forest for lumber should be managed on the basis of production yield and maturity. It seems probable that the grazing economy of the Upper Valley Allotment will change more to a lumbering economy within the next half century.

Examination of Agricultural Potentialities

It seems feasible with our present development of roads and transportation facilities, that the remaining arable land of the Escalante Valley might well produce a different agricultural product. The rich, sandy clay loams of these valleys would support truck garden fruits and vegetables. This is problematic, but it might prove to be more profitable to the economy of the people than the present alfalfa, grain and potatoes which are cultivated in the fields. Truck gardening has proved most successful in many parts of the State, where people interested in deriving a livelihood from the soil, have found it most profitable. With the limited arable land and water for its irrigation in the Escalante Valley truck gardening would be one possible way whereby the arable land could produce more profitable yields than what it is currently producing.

Crop rotation should be employed in depleted soils of the area because one crop such as alfalfa grown of the same land for 20 years is certainly not producing yields that the cultivated land should produce.

Dairy farming might be more profitable to the individual farmer than the present use of the arable land for alfalfa and grain.

Poultry farming has proved most successful in areas of the State and might well prove to be equallyas successful in Escalante.

All of these suggestions are problematic, but certainly they deserve consideration and experimentation to a degree far beyong the present utilization of the arable land.

Educational Needs

The previous suggestions on the more apparent remedial measures applicable to the Escalante area were made with full awareness that perhaps none of them are likely to be accepted by the people of the community without first an intensified and enlightened educational program. Most of the people of this community are certainly aware that they are economically impoverished. Many of the older people of this community could perhaps dubiously boast of experiencing a complete transition from rags to silk and back to rags within one short lifetime. But I doubt whether many would boast of understanding the basic factors underlying their present economic status or why a once-productive land should now withhold its bounties from them. Yet few observant visitors from the outside fail to diagnose immediately their trouble.

The following excerpt from Arthur Gaeth's news analysis of July 1, 1951, KSL, Salt Lake City, Utah, gives his impressions, as a layman, of

the area as it appeared to him:

> Last week I visited one of the most scenic sections in Utah--the country around Escalante in Garfield County. I travelled on to Boulder and Wayne Wonderland--saw the great chasms--the beautiful reds, blues, whites and yellows of those picturesque mountains--the giant trees and cool forests--the sunlight and shadows on inviting Fish Lake where fishermen are making good catches. But I also witnessed plenty of inundation--results of more than a year of drought--and the work of cattle and sheep men so interested in their own returns that they have worn out the pasture, hastened the erosion, and destroyed watersheds until a whole community is threatened with impoverishment. Not so many years ago Escalante had 1,200 people. The ranges carried 20,000 cattle and 60,000 sheep. The grass was high--the streams winding--the water retarded. Today conditions are such that unless the community turns to conservation, unless cattle and sheep allowed to roam the range is further reduced by one-half, the area will beturned to wasteland and the people will be forced to accept further relief or move away. I wandered over that range and saw the results--also the pitiful attempts being made at private pasture. The hope is in the younger generations--that they will realize that we just can't take--that from time to time investment must be made and nature helped to put back some of her wealth. Today in that whole southeastern area, reservoirs are needed; but those that exist are threatened with silt. Because the hillsides are bare, the rainwater runs off and gashes out huge streambeds with all the top-soil carried away down to the Colorado. In that area, unless we become conservation minded we human beings will soon have created a new Sahara.

The observations made by Mr. Gaeth regarding current land and water conditions of the Escalante area are significant because they were made by a person essentially untrained in the science of ecology and resource management. Yet the cause-effect relationship between land abuse and poor people was obvious to him.

It is the writer's contention that the majority of people in Escalante fail to grasp the significance of their economic impoverishment for various reasons. The older people are stock men or retired cattle and sheep owners who have witnessed a gradual rather than a sudden decline of the range and

and water resources. It is far easier and more convenient for these people to attribute this economic loss to acts of God rather than to their own sins against the land. And in this conclusion they are not greatly different from the average stock man in other communities who has experienced similar reverses due to the same causes. The youth of Escalante have known nothing else than a rebellious Nature, and they accept their difficult status with calm resignation.

A common cry of the people of Escalante is "If we only had more water." Yet when the writer visited the North Creek Reservoir in August, 1952, a tormented feeling of despair came over him for these people, his people who are sitting idly unaware while siltation is rapidly rendering their main water resource useless. The North Creek Reservoir was the only feasible site for such a dam and it was built by a desperately poor community at a cost of $85,000.00. Unrealized by the people is the fact that the silt and topsoil filling the reservoir originates from upstream meadows and forests. The stabilization of the meadows and forests can only result from further reduction in livestock now grazing that watershed.

In dollars and cents the water stored in North Creek Reservoir for use on cultivated fields has an economic value to the people of Escalante many times that of the value derived from the cattle which utilize the watershed for grazing. Yet the citizens of the community resist any remedial measures for control of the watershed suggested by the forest personnel.

The awareness regarding this catastrophe will only be attained through a well-informed teaching program. The only possible approach to this

community problem is through organizations such as church, schools and various civic groups. The seriousness of this land abuse must be a basic part of every child's education. The responsibility for the teaching of resource conservation is a moral duty of every person. Committees involving people of the community should be organized and field excursions by all citizens under capable leadership should be taken to such places as North Creek slump areas, the Upper Valley Allotment, the denuded and eroded areas on the Canaan Mountain, the mountain slopes of Griffin Top and Barney Top of the Escalante Mountains. From such field experiences an analysis of the data should be made by the people of the community, and a positive program of soil and water conservation should be established. These findings must be related to man's use of his resources and his economy.

What do such figures on range and stock decline as those found in Tables 6 and 7 mean to the people of Escalante? What do they mean to people in similar communities throught the state? Some folk are resentful. They maintain that such reduction in livestock numbers by the Forest Service was as unnecessary as it was autocratic. Others maintain that siltation would continue regardless of number of cattle removed from the watershed. Some few admit that the white man's history in the Escalante area is a sad but meaningful story of the consequences that must inevitably follow man's failure to live in complete harmony with nature. They know now that man, like other animals of the land, must contribute to the earth's renewable fertility if the human species is to survive; thatthe total biological community of which man is a part, but which he so often ignores, must be recognized and supported; that his fate lies in his own hands.

Belatedly, a few people of Escalante thus realize not only that conservation involves a set of "don'ts" necessary to insure their own livelihood, but that it must be accepted as a new gospel by each generation in order to establish a moral right to use the renewable agricultural resources of an economic geographic area.

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A CHECK LIST OF THE PLANTS TAKEN IN EACH PLANT COMMUNITY OF THE UPPER VALLEY ALLOTMENT

Wet Meadow

Abronia pumila Rydb.
Agropyron desertorum (Fisch.) Schult.
Agrostis alba L.
Agrostis palustris Huds.
Aplopappus laricifolius Gray
Avena fatua L.
Campanula Parryi Gray
Carex nebraskensis Dewey
Carex petasata Dewey
Cicuta Douglasii (DC.) Coult. and Rose
Cirsium arizonicum (Gray) Petrak.
Clematis hirsutissima Pursh.
Dithyrea Wislizeni Engelm.
Dodecatheon radicatum Greene
Eleocharis palustris (L.) Roem. and Schult.
Equisetum laevigatum A. Braun
Erigeron lonchophyllus Hook.
Festuca elatior L.
Hordeum jubatum L.
Iris missouriensis Nutt.
Juncus balticus Willd.
Juncus ensifolius Wikstr.
Juncus saximontanus A. Nels.
Phleum pratense L.
Plantago eriopoda Torr.
Poa Canbyi (Scribn.) Piper
Poa nevadensis Vasey
Populus angustifolia James
Ranunculus circinatus Sibth.
Salix exigua Nutt.
Scirpus acutus Muhl.
Smilacina racemosa (L.) Desf.
Triglochin maritima L.

Dry Meadow

Achillea lanulosa Nutt.
Asclepias speciosa Torr.
Atriplex confertifolia (Torr. and Frem.) Wats.
Distichlis stricta (Torr.) Rydb.
Festuca Grayi (Abrams) Piper
Gilia longiflora (Torr.) G. Don.
Hymenopappus lugens Greene
Lesquerella intermedia (Wats.) Heller
Muhlenbergia glauca (Nees) Nez.
Nepeta Cataria L.
Sarcobatus vermiculatus (Hook.) Torr.
Sporobolus airoides Torr.
Sporobolus contractus Hitchc.
Sporobolus cryptandrus (Torr.) Gray

Sub-Montane Brush Association

Allium acuminatum Hook.
Andropogon scoparius Michx. var. neomexicanus (Nash) Hitchc.
Arnica cordifolia Hook.
Artemisia dracunculoides Pursh.
Artemisia frigida Willd.
Artemisia tridentata Nutt.
Aster commutatus Gray var. polycephalus (Rudb.) Blake
Castilleja chromosa A. Nels.
Castilleja confus Greene
Chaenactis Douglasii (Hook.) Hook. and Arn.
Chrysothamnus nauseosus (Pall.) Brit.
Chrysothamnus teretifolius (Dur. and Hilgard) H. M. Hall
Chrysothamnus viscidiflorus (Hook.) Nutt.
Cirsium Andersonii (A. Gray) Petrak
Cirsium Rydbergii Petrak
Cryptantha flava (A. Nels.) Pays.
Erigeron concinnus (Hook. and Arn.) Torr. and Gray
Erigeron flagellaris Gray
Eriogonum umbellatum Torr.
Gilia aggregata (Pursh) Spreng.
Gilia aggregata Pursh var. arizonica (Greene) Fosb.
Gutierrezia Sarothrae (Pursh) Britt. and Rusby
Hymenoxys acaulis (Pursh) K. F. Parker var. arizonica
(Greene) Parker
Lesquerella intermedia (Wats.) Heller
Myosotis scorpioides L.
Oenothera caespitosa Nutt. var. marginata (Nutt.) Munz
Salsola Kali L.
Senecio multilobatus Torr. and Gray
Tetradymia canescens D. C.

Forest

Antennaria aprica Greene
Antirrhinum Nuttallianum Benth
Apocynum cannabinum L.
Baileya multiradiata Harv. and Gray
Baileya pleniradiata Hook. and Gray
Berberis Fremontii Torr.
Calochortus Nuttallii Torr. and Gray
Cowania mexicana D. Don
Ephedra viridis Cov.
Erigeron strigosus Muhl.
Fraxinus anomala Torr.
Habenaria hyperborea (L.) R. Br.
Juniperus osteosperma (Torr.) Little
Lygodesmia spinosa Nutt.
Penstemon utahensis Eastw.
Petalostemum Searlsiae Gray
Physalis Fendleri A. Gray
Pinus edulis Engelm.
Purshia tridentata (Pursh) DC.
Sambucus coerulea Raf.
Shepherdia rotundifolia Parry
Sidalcea neomexicana Gray
Yucca baccata Torr.

Ponderosa Pine Forest

Arctostaphylos pungens H.B.K.
Aster canescens Pursh
Baileya multiradiata Harv. and Gray
Chrysothamnus teretifolius (Dur. and Hilgard) H.M. Hall
Eriogonum racemosum Nutt.
Gentiana affinis Griseb.
Lupinus Kingii Wats.
Lupinus sericeus Pursh
Oenothera pallida Lindl.
Penstemon subglaber Rydb.
Phoradendron californicum Nutt.
Pinus ponderosa Laws.
Potentilla crinita Gray
Potentilla fruticosa L.
Sambucus coerulea Raf.
Sambucus racemosa L.
Solidago canadensis L.
Solidago ciliosa Greene
Wyethia arizonica Gray

Upper-Montane Brush

Acer glabrum Torr.
Amelanchier oreophila A. Nels.
Amelanchier utahensis Koehne
Betula fontinalis Sarg.
Cercocarpus intricatus Wats.
Cercocarpus ledifolius Nutt.
Cornus stolonifera Michx.
Lepidium Fremontii Wats.
Quercus Gambelii Nutt.
Rhamnus betulaefolia Greene
Rhus trilobata Nutt.
Ribes inebrians Lindl.
Ribes montigenum McClatchie
Rosa Fendleri Crepin
Rosa Woodsii Lindl.
Salix lutea Nutt.
Senecio millelobatus Rydb.
Shepherdia argentea (Pursh) Nutt.
Symphoricarpos oreophilus Gray
Vicia americana Muhl.

Upper-Montane Forest

Abies concolor (Gord. and Glen.) Hoopes
Abies lasiocarpa (Hook.) Nutt.
Acer grandidentatum Nutt.
Aster foliaceus Lindl.
Ceanothus Fendleri Gray
Berberis repens Lindl.
Festuca elatior L.
Festuca ovina L.
Geranium Fremontii Torr.
Geranium Richardsonii Fisch.
Helenium Hoopesii Gray
Holodiscus dumosus (Nutt.) Heller
Juniperus communis L.
Juniperus scopulorum Sarg.
Picea Engelmanii Parry
Picea pungens Engelm.
Pinus aristata Engelm.
Pinus flexilis James
Populus tremuloides Michx.
Potentilla crinita Gray
Prunus virginiana L.
Rhamnus betulaefolia Greene
Shepherdia canadensis (L.) Nutt.

Grasses

Agropyron dasytachym (Hook.) Scribn.
Agropyron desertorum (Gisch.) Schult.
Agropyron inerme (Scribn. and Smith) Rydb.
Agropyron reparium Scribn. and Smith
Agropyron repens (L.) Beauv.
Agropyron Smithii Rydb.
Agropyron Smithii Rydb. var. molle (Scribn. and Smith) Jones
Agropyron subsecundum (Link) Hitchc.
Agropyron trachycaulum (Link) Malte
Agrostis alba L.
Agrostis palustris Huds.
Bromus ciliatus L.
Bromus tectorum L.
Calamagrostis inexpansa A. Gray
Deschampsia caespitosa (L.) Beauv.
Elymus triticoides Buckl.
Festuca elatior L.
Glyceria striata (Lam.) Hitchc.
Hordeum jubatum L.
Koeleria cristata (L.) Pers.
Poa Canbyi (Scribn.) Piper
Poa pratensis L.
Polypogon monspeliensis (L.) Desf.
Puccinellia airoides (Nutt.) Wats. and Coult.
Sitanion hystrix (Nutt.) J.G. Smith
Sporobolus airoides Torr.
Sporobolus contractus Hitchc.
Sporobolus cryptandrus (Torr.) A. Gray
Sporobolus flexuosus (Thurb.) Rydb.
Stipa comata Trin. and Tupr.
Stipa Lettermani Vasey

A CHECK LIST OF MAMMALS OF THE UPPER VALLEY ALLOTMENT WITH NOTES ON THEIR ECOLOGY

Throughout the course of this study rodents and other mammals were observed and collected. Even though the writer is aware of the incompleteness of the study, he believes the data sufficient to warrant recording. The data gained have contributed to a much better understanding of the overall ecology of the area. The mammals and notes on their habitat preferences will be discussed under each kind. The names used in the checklist are those employed by Durrant (1952).

Scientific Name	Common Name
Sorex cinereus cinereus	Masked shrew
Sorex vagrans monticola	Vagrant shrew
Sorex palustris navigator	Water shrew
Eptesicus fuscus pallidus	Big brown bat
Ursus americanus cinnamonum	Black bear
Bassariscus astutus nevadensis	Ringtail cat
Taxidea taxus taxus	Badger
Mephitis mephitis major	Striped skunk
Mustela frenata nevadensis	Long tailed weasel
Urocyon cinereoargenteus scottii	Gray fox
Canis latrans lestes	Coyote
Felis concolor kaibabensis	Mountain lion
Lynx rufus baileyi	Bob cat
Erethizon dorsatum epizanthum	Porcupine
Marmota flaviventer engelhardti	Woodchuck
Tamiasciurus hudsonicus fremonti	Chicaree
Citellus variegatus utah	Rock squirrel
Citellus leucurus escalante	Antelope squirrel
Citellus lateralis lateralis	Golden-mantled ground squirrel
Glaucomys sabrinus lucifugus	Flying squirrel
Eutamias minimus consobrinus	Least chipmunk
Eutamias umbrinus adsitus	Say chipmunk
Eutamias quadrivittatus hopiensis	Hopi chipmunk
Thomomys talpoides levis	Northern pocket gopher
Thomomys bottae howelli	Botta pocket gopher

Indian Springs on the Boulder Mountain in the summer of 1953.

Bassariscus astutus nevadensis. The ringtailed cat was observed on the Kaiparowits Plateau in the sandstone formation supporting a pigmy-juniper forest. This mammal was very rare in the Allotment.

Taxidea taxus taxus. The badger was observed only once, but diggings of this mammal were common in both the valley and the benchlands in pinyon, juniper, and ponderosa pine communities. No specimens were collected.

Mephitis mephitis major. The striped skunk was observed in the valley by an old abandoned house on the Henry Heaps' Ranch. This mammal was very rare and no specimens were collected.

Mustela frenata nevadensis. The long tailed weasel was seen in a dense stand of Salix, Rosa community in the Ranger Station pasture. No specimens were collected.

Urocyon cinereoargenteus scottii. The gray fox was seen on the south slope of the Canaan Mountain near the Horse Spring Draw in a pinyon-juniper community. Only one mammal was seen and no specimens were collected.

Canis latrans lestes. The coyote is extremely rare in this area today. The four consecutive summers that the writer was in the field, he failed to observe even one, or hear the wail of this animal at night--a familiar sound to the camper in these mountains only a short decade ago. They have been destroyed by poison bait.

Felis concolor kaibabensis. The mountain lion, a very large cat which was once abundant in this region of the Kaiparowits Plateau, is very rare there today. One mountain lion was seen in the Upper Valley in 1952. This cat, immature, was observed in the sub-montane brush community.

Lynx rufus baileyi. The bobcat is found in the Allotment. No bobcats

were seen, but tracks of this mammal were common in the sands of the pigmy-juniper forest, and the muds of the arroyo.

Erethizon dorsatum epizanthum. The porcupine was the largest rodent seen in the Allotment. This rodent has become very abundant. It lives in the pinyon-juniper communities, and also the ponderosa pine community from which its food is obtained in the winter months. The porcupine has barked a large number of young trees, both pinyon and yellow pine. Five of these mammals were observed in a ponderosa stand within a 20 foot radius.

Marmota flaviventer engelhardti. The woodchuck was commonly seen on the south and west slopes of the Canaan Mountain in and among rocky places above 7,000 to 8,500 feet. They were also found on the talus outcroppings of the Table Cliff Plateau in the foxtail and limber pine communities.

Tamiasciurus hudsonicus fremonti. The chicaree, often called the tree squirrel because of its climbing habit, was collected in the spruce-fir community of Water Canyon, and observed in the spruce-fir community of Canaan Mountain in areas above 8,000 feet.

Citellus variegatus utah. The rock squirrel is the big common gray squirrel of the brush and pinyon communities. This mammal was taken in a dense community of sagebrush at 7,000 foot elevation. It was common along the arroyos and steep broken slopes of the canyon.

Citellus leucurus escalante (MS) Hansen. The antelope squirrel was observed and collected on the benches and sandy hillside of the Kaiparowits Plateau at elevations of 7,000 feet.

Citellus lateralis lateralis. The golden-mantled ground squirrel, a large ground squirrel, was collected on all areas of the Allotment in the ponderosa pine belt and neighboring communities. Some 30 specimens were

taken from the allotment.

Glaucomys sabrinus lucifugus. The flying squirrel was not observed in the Allotment, but Lee in his "Mammals of the Aquarius Plateau" said it occurred in all the dense conifer forests of spruce-fir climax.

Eutamias minimus consobrinus. The least chipmunk, a small chipmunk, was common in all vegetation communities in the Allotment. They were collected from the dry meadow of the valley to the summit of the Table Cliff Plateau.

Eutamias umbrinus adsitus. The say chipmunk was taken in both sagebrush communities as well as pigmy-juniper and ponderosa forests from elevations of 7,00 to 9,000 feet.

Eutamias quadrivittatus hopiensis. The Hopi chipmunk was observed in the canyons in a pinyon-juniper forest at elevations of 6,000 feet on the Kaiparowits Plateau.

Thomomys talpoides levis. The northern pocket gopher was common in the upland valley fringes at elevations of 8,000 feet and above. They inhabited the areas of the aspen forests and the summit of the Table Cliff Plateau.

Thomomys bottae howelli. The botta pocket gopher was common in the valley in both the wet and dry meadow association and was found as high as 7,000 feet.

Dipodomys ordii cupideneus. The Ord kangaroo rat was taken in sandy valley fills of the canyons in a sagebrush-pigmy forest at elevations of 6,500 feet. Track and tail markings were common on these sandy soils, but only two specimens were collected.

Perognathus parvus trumbullinsis. The Great Basin pocket mouse was

taken in the valley. Only five mammals were collected, three of them in the reseeded areas in the Allotment at elevations of 6,000 to 7,000 feet.

Erithrodontomys megalotis megalotis. The harvest mouse was collected in a dense grass cover of Agrostis alba at elevations of 8,000 feet. Only three specimens were collected, one of these was taken in the crested wheat grass near Pole Springs.

Peromyscus crinitus douttii. The canyon mouse was very common in the canyon that leads from the valley. They were taken in heavy, broken, rocky slopes of sagebrush and pinyon association at an elevation of 6,500 feet.

Peromyscus boylii utahensis. The brush mouse was taken in the same habitat as the canyon mouse at an elevation of 6,500 feet.

Peromyscus maniculatus sonoriensis. The deer mouse was the most abundant mammal collected in the Allotment. In every trap line a large per centage of the catch was the deer mouse. It was found at all elevations in the Allotment.

Peromyscus truei truei. The pinon mouse was collected in the pinyon-juniper forest among large broken boulder rocks and in the fallen talus of the sandstone ledges at elevations of 6,000 feet.

Neotoma lepida sanrafaeli. The desert wood rat was collected in the canyons where the sandstone ledges had broken and formed large rock piles at their base. It was a sagebrush-pinyon-juniper association at elevations of 6,500 feet.

Neotoma cinerea acraia. The bushy tailed wood rat was not collected, but was observed in an old log house at the head of South Hollow in a rabbit brush community. The elevation was 8,000 feet.

Microtus longicaudus latus. The long tailed meadow mouse was very

common in all the wet meadows of the Allotment. It was collected at elevations of 7,000 to 8,500 feet.

Microtus montanus amosus. The montane meadow mouse was not collected, but evidence of its presence was observed in the wet meadows on top of the Table Cliff Plateau where a network of paths had been made by the mouse.

Ochotona princeps utahensis. The pika was not collected but it and its haystacks were observed on the steep talus slopes of the Table Cliff Plateau at elevations of 10,000 feet and above. It was restricted to areas in the upper-montane areas.

Lepus californicus deserticola. The black tailed jack rabbit was not collected, but was observed in the sagebrush and pigmy association of the Allotment at elevations ranging from 6,000 to 8,000 feet. One jack rabbit was observed in the ponderosa and in aspen at 9,000 feet on the Table Cliff Plateau.

Sylvilagus audubonii arizonae. The audubon cottontail was collected in the sagebrush and pinyon associations of the Upper Valley Allotment and was common in the areas up to an elevation of 7,000 feet.

Sylvilagus nuttallii grangeri. The Nuttall cottontail was observed in the upper-montane forest, aspen community, on the Canaan Mountain at 9,000 feet elevation.

Odocoileus himconus hemionus. The mule deer was not collected, but does and fawns were observed in the pigmy-juniper forest and the montane brush association. The bucks were observed in all zones from 6,000 feet to the summit of the Plateau. It is estimated by the forest rangers that there are at least 300 deer grazing in the Allotment annually.

Special
Range Report

Escalante, Utah
October 25, 1935

Memorandum for Mr. Standing:

According to the two statements received and to several conversations I have had with men who have lived in this country since shortly after it was settled it is easy to conclude that at that time the statement made by Mr. Griffin (see his signed statement) was justified. He says, "About this time (1880) this country was getting a real reputation for it's wonderful range." Mr. Porter states that at about the time the country was settled "There was grass everywhere so thick that one could throw his hat or a blanket down any place and it would never touch the ground." Mr. Porter also mentions the fact that one could easily stake a horse out almost any place and he could get all he wanted to eat over night. This or very similar statements have been heard a number of times, also that when riding across certain flats the grass would drag the stirrup. Such statements as these are almost impossible to believe especially when one knows that the men making them have nothing to gain by them and in many cases are actually doing themselves harm in that they have a preference upon this once luxuriant range which is so badly depleted at present and that they have been an agent to it's destruction -- an honor no rational thinking man would want to claim. Many of the older men can see the folly of this early mistake of heavy and early stocking of the range for they can see what it has led to. On the other hand many of the younger ones who have high hopes of making a "stake" in the stock business still tell how good the range is.

Protected areas and statements of men point out that grass and other good forage species once predominated on this range. Mr. Griffin states, "The desert used to have a lot of white greasewood on it but all this has been killed before now. (According to a description of the plant and where some of it grows at present this is an Atriplex -- probably Atriplex canescens). There was also a lot of sand grass and another grass that looks like wheat grass but is fuzzy on top (Hilaria), then too there was a lot of buffalo (Grama)grass like that growing there now. All of these but the buffalo grass has been killed out." After signing the statement Mr. Griffin stated that it "seemed like after the white grease wood and the grasses were killed out this Russian thistle (Salsola) came in all at once and took the whole range over on the desert."

In each statement submitted and according to several other verbal statements there were no washes in the country until it had been heavily grazed by the stock. Mr. Porter states that, "The first flood I remember seeing came off the mountain about 1887 but we thought nothing of it. Before that time it could rain for days and the streams never got muddy. About that time I can remember there used to be a small bridge across the Escalante Creek down here in the field lane, it was perhaps twelve feet

across it and today it is about 400 feet across and 20 feet deep -- all caused in the lifetime of one man." Mr. Griffin states, "Floods started to come down into the valley about 1890 and then by the early 1900's floods started in earnest. It was at this time the Alvey wash and the Escalante Creek got so big. Previous to that time neither of these were very large. I remember when a one span bridge spanned either creek and there was a large patch of willows and several swamps along the Escalante Creek." Today, as stated, each of these washes are from 100' to 400' across and about 20' deep, there are no willows and no swamps in the vicinity. Floods and deep gullies are common today.

Mr. Griffin states, "As I remember there have never been but a very few deer on the desert range and I have never seen any antelope here though there used to be a lot of them over on the East Fork of the Sevier River." Also, "There used to be a lot of deer in the mountains around here. I remember the Indians used to come here and hunt and on one occasion I remember there were perhaps a hundred of them and they just lined up and combed the country killing the deer clean as they went. They would just take the hide and in some cases maybe a hind quarter and leave the remainder of the carcass lay." He also says, "There were a few mountain sheep here too."

Since that time deer in this country have become scarce, the antelope have become extinct and according to a few men there are only a few head of mount in sheep left and these are down next to the Colorado River in country which is practically inaccessible to man.

There is probably a lot of truth in a statement once heard, "The people of this intermountain country have made this desert blossom as the rose, but too, within a short distance of the bloom they have made it ten times more like a desert."

The following table shows what is happening on the Escalante desert range. Plot number 1 was taken in the Escalante cemetery where the range has been protected against livestock for a number of years, though at the time it was set aside as a cemetery all the brush was grubbed out of it. Plot number 2 was taken on private range on the east and adjoining cemetery. This range has been grazed but not so heavily as the outside or public range. Plot number 3 was taken on open public range on the south side and adjoining the cemetery.

TABLE I

A Comparison of Protected, Partly Protected and Open Range.

Plot No.	Designation	Density	% Gr.	% Wd.	% Br	F.A.F.	Status
1	Gm-Gr	.37	91	4	5	.2416	protected
2	Gm-Snw	.30	89	4	7	.1992	partly protected
3	Gm-Salsola	.20	43	45	12	.0829	open public

The browse which formerly grew on this type was a good palatable browse so no doubt it has suffered considerable. In plot number 1 this was all grubbed out but some has come back. On plot number 2 there is still some left but the naked dead stems are numerous. On plot number 3 there are some dead stems left but there is no doubt but that most of them have entirely rotted away at this late date.

The following table shows what was found on each plot and the per cent each made of the total cover:

TABLE II

Plants and the Per-centage of Each Found on Plots 1, 2 and 3.

Species	Plot 1	Plot 2	Plot 3
Grass.	91%	89%	43%
Bouteloua	82	88	43
Hilaria	6	1	0
Oryzopsis	1	0	0
Sandgrass (?)	2	0	0
Weeds.	4%	4%	45%
Sidalcea	1	½	0
Salsola	2	½	40
Eriogonum	1	0	0
Chamaesyce	0	0	2
Others	0	3	3
Browse	5%	7%	12%
Artemisia tri.	2	2	1½
Gutierrezia	2	5	9
Atriplex	1	0	0
Chrysothamnus	0	0	1½

It will be noted that plot number 1 has several species of grasses, plot number 2 only two and plot number 3 only one which is Bouteloua--past observations bear this out, namely that Bouteloua will probably stand as much abuse as any of the grasses. The unfortunate thing about this grass is the variation in the amount of feed it produces from yeam to year.

The above tables tend to bear out the statements made by Mr. Griffin with respect to the vegetative cover on the desert.

The following table of plots numbers 4 and 5 also point out the above differences. Plot number 4 is made on the open or public range and plot number 5 is made on the adjoining area in Orrin's Pasture. Both are out on the Big Flat about five miles east of Escalante. While this pasture has not been grazed as heavily as the outside range it has been abused. There are a number of old dead Atriplex bushes on the area indicating the stand was much heavier than at present. There are some dead Atriplex bushes on the outside also but no living ones were visible from there.

TABLE III

Comparisons of Plots 4 and 5.

Plot No.	Designation	Density	% Gr.	% Wd.	% Br.	F.A.F.	Status
4	Gr-Wd-Br	.23	37	38	25	.0732	open range
5	Gm-Wd-Br	.33	70	20	10	.1986	pasture

TABLE IV

Plants and Per-cent of Each Found on Plots 4 and 5.

Species	Plot 4	Plot 5
Grasses	37%	70%
Bouteloua	25	65
Hilaria	10	4
Sandgrass (?)	2	1
Weeds	38%	20%
Salsola	30	1½
Chenopodium	7	17
Sidalcea	1	0
Cleome	0	1½
Browse	25%	10%
Gutierrezia	25	6
Atriplex	0	4

As has been stated, after Mr. Griffin signed his statement he said, "Seemed like after the white greasewood and the grasses were killed out this Russian thistle (Salsola) came in all at once and took the whole range over on the desert." This about covers the situation so far as the noxious weed situation is concerned on the desert. Salsola is the only one of any consequence.

The portion of the desert below the Ten Mile (about ten miles southeast

of Escalante) is probably about 50 to 75 per-cent depleted while that range this side of the Ten Mile and immediately around town is 75 to 100 per-cent depleted.

As to the eroded condition of the desert I cannot say and I have been so rushed that it has been impossible for me to get any data from the field.

I do not believe the change in plant cover has had any particular effect on the number of game. In my opinion man and the early methods of control are entirely responsible for the decrease in numbers of deer and mountain sheep in this vicinity and for the extinction of antelope o n the East Fork of the Sevier River.

Floods and erosion are both very serious problems in this vicinity, already perhaps 250 acres of valuable land has become part of the Escalante Creek or wash alone and this for a depth of from 10 to 20 feet. The prospects are that considerable more will "be washed away" too before floods in this vicinity are entirely controlled. During two periods of the CCC camps a considerable sum of money has been spent for the purpose of checking this "monster," in the construction of the Potatoe Wash Dam and in erosion control in the head of Main Canyon. Too, the citizens of this community have spent several thousands of dollars in putting in a diversion dam so they could take water from the creek for use in irrigation. At present some of the land adjoining the Escalante Creek or Wash has little sale value because of the ever present possibility of further erosion. In several cases the water right has been sold and the land abandoned.

Indeed the depletion of the ranges in this country has been a terrible blow to the stock industry in this community and especially so since it has been and still is it's whole means of support. Mr. Porter estimates (in his statement) that at one time (about 1900) there were about 15,000 to 20,000 head of cattle and about 80,000 head of sheep in this vicinity -- today there are about 7,000 head of cattle and about 21,000 head of sheep. And whereas the sheepmen used to use the same bed ground all winter they now have to trail their sheep over a distance of perhaps 250 to 300 miles during the course of the winter to find feed for them. Last spring, after the cattle had wintered fair, the cattlemen had an estimated loss of about 25%, most of which were cows heavy with calf. Mr. John King, of Boulder, had charge of a number of the projects when putting troughs in at springs and seeps on the public domain last spring. On one occasion he made the following remark to me,"If the Government would tell me I could have all this land around the springs we are developing if I would pay for the developments I wouldn't even thank them for the offer." A number of men in this vicinity have expressed a similar opinion yet this is the only place these same men have to run their stock in the winter for they produce little more than enough hay to feed their work, milk and saddle stock during the winter. The winter loss among sheep in this country usually averages from 10 to 20 per-cent.

In the spring when the stock are brought off the winter range, they

are all poor and usually very weak. Often while tagging the Boulder cattle one will get down in the shoot and will not be able to get up alone. When such a condition prevails there is no doubt but that the profits, if any, in the livestock industry are eaten up on the winter losses on the winter range which here is the desert. Too, the costs of operation under such handicaps are excessive.

Under such conditions the community as well as the individual ranches or individuals suffer. Maybe this has something to do with the fact that Garfield county had 54% of its families on the direct relief rolls during the past spring and summer. One county commissioner estimated that if Garfield county had its just dues it would own about 60% of the farms in Escalante on account of delinquent taxes.

And in Escalante it is estimated that 69% is on government relief.

Respectfully submitted,

J. Deloy Hansen

Escalante, Utah
Oct. 23, 1935

TO WHOM IT MAY CONCERN:

Escalante was settled in about 1875 or 1876. I came into the country in about 1879. When I came into the country there had only been a few head of sheep around here and these had about all been lost or killed by the varmits. I brought about 1500 head in with me. About this time this country was getting a real reputation for its wonderful range so by about 1885 there were about 15,000 head of sheep in this vicinity. The first settlers brought a lot of cattle in with them but by about 1885 to 1890 a lot of cattle were being brought into the country to winter and there were perhaps 15,000 head of cattle owned here besides a couple of thousand head of wild horses -- they were all over the desert. The people used to turn their gentle horses out and they would get with the wild ones so they had difficulty in catching their own. For this reason many of the wild ones were killed. As I remember there have never been but a very few deer on the desert range and I have never seen any antelope here though there used to be a lot of them over on the East Fork of the Sevier River.

The desert used to have a lot of white greasewood on it but all this has been killed out before now. (According to a description of the plant and where some grows at present this is an Atriplex). There was also a lot of sand grass and another grass that looks like wheat grass but is fuzzy on top (Hileria), then too there was a lot of buffalo grass like that growing there now. All of these but the buffalo grass has been killed out.

My Father, brother and I were the first men to take sheep onto the mountain (now Forest), we used to run our sheep up North Creek and then a few years later we took them out onto Griffin top. We built cabins and stayed in them and as was the practice, bedded our sheep near by each night. At that time the feed was good and I believe the grass growing there at that time was just the same as growing there now except there used to be a lot of bunch grass growing around in the timber and in the edge of the open flats. Griffin Spring draw had a large patch of willows growing in it, there was perhaps twenty acres.

There used to be a lot of deer in the mountains around here. I remember the Indians used to come here to hunt and on one occasion I remember there were perhaps a hundred of them and they just lined up and combed the country killing the deer clean as they went. They would just take the hide and in some cases maube a hind quarter and leave the remainder of the carcass lay.

Floods started to come down into the valley about 1890 and then by the early part of the 1900's floods started in earnest. It was at this time that the Alvey wash and the Escalante Creek got so big.

Previous to this time, neither of these were very large. I remember when a one span bridge spanned either creek and there was a large patch of willows and several swamps along the Escalante creek.

At present, Escalante Creek is from 100' to 400' wide and about 20' deep.

There have never been many ducks in the country and I have only seen one bunch of sage hens around here. There were a few mountain sheep here too.

E. A. Griffin.

Escalante, Utah
Oct. 22, 1935

TO WHOM IT MAY CONCERN:

Escalante was settled in 1875. Prior to that time a few men had run a few head of cattle in this country. There was grass everywhere so thick that once could throw his hat or a blanket down any place and it would never touch the ground. In about 1890, I remember going out on the desert on a rabbit hunt, I was only a big kid at the time and was driving a team on a wagon. At the time there was a lot of dry grass around and I remember one of the fellows set a fire in it and it burned for several days and covered practically the whole country. Along about this same time several fellows from over around Filmore and Kanosh brought a lot of cattle into the country and a lot of sheep came in from up around Sanpete. The number increased until in about 1900 there must have been between 15 and 20 thousand head of cattle in the country and perhaps 80,000 head of sheep. Beside all the wild horses and there must have been several thousand of them, anywhere you want whether it was up on the mountain or out on the desert you seen them in big bands. There was also a lot of deer and some antelope in the country. The last bunch of antelope I remember seeing was over in Johns Valley in about 1908. The Indians used to kill the deer just for their hides and leave the carcasses lay. The antelope were also killed just for the love of killing.

I helped Griffins take their sheep out on Griffin Top about the first time sheep were ever taken out there, that was about 1890. I remember the grass was so high that you could hardly see the sheep for it. Griffins Spring Draw was just a large willow patch from one end to the other. While we were herding sheep in that country we never did turn our horses loose, we just tied them with a long rope and they could get all they wanted to eat during the night. We always brought the sheep back to the same bed ground each night and they never had to go very far away during the day to get all they wanted to eat. We did the same down on the desert during the winter. Griffins built some small cabins and camped in them all winter and bedded their sheep on the same bed ground for three or four months at a time. Everyone handled their stock the same way until the feed started to get scarce, then they had to move around a little for good food but they never did have to take them off the desert in those days to winter them.

About three years after the sheep went up into North Creek the streams started to get muddy every time it rained. The first flood I remember seeing come off the mountain was about 1887 but we thought nothing of it. Before that time it could rain for days and the streams never got muddy. About that time I can remember there used to be a small bridge across the Escalante Creek down here in the field lane, it was perhaps twelve feet across it and today it is about 400 feet across and 20 feet deep -- all caused in the lifetime of one man.

Even at the time the Forest was created the Mountain range was badly depleted and floods were common. At that time about 150,000 head of

transient sheep were forced out of the country because the government would not issue a permit to them. Since that time the mountain or Forest range has come back considerable but I don't believe it is over 50% as good now as it used to be. The desert range has continued to go down until it will care for less than 10% of what it would formerly.

/S/ Jos. J. Porter
Jos. J. Porter